Westchester Medical Center
Contract No. CMC - 02956 GC, M, E, P
Multiple Prime Contracts

USP 800 Pharmacy Upgrade –
Issued for Bid
07/14/23

TECHNICAL SPECIFICATIONS

INTRODUCTORY INFO

DIVISION 01 – GENERAL REQUIREMENTS

DIVISION 02 - SITE WORK (see also Div. 02 keynotes on drawings)

DIVISION 03 - CONCRETE

DIVISION 04 – MASONRY

DIVISION 05 - METALS

DIVISION 6 - WOOD AND PLASTICS

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SECTION 011000
SUMMARY OF THE WORK

PART 1 GENERAL

1.01 WORK COVERED BY THE CONTRACT DOCUMENTS

A. The title and location of the work is printed on the cover of this Project Manual.
B. Type of Contract: Fixed price.
C. This project includes Interior Alterations and Exterior Alterations of the following: Mid-Hudson Hospital in Poughkeepsie, NY.
D. The work includes upgrades and modifications to existing HVAC, plumbing, sprinkler, power, lighting, fire alarm, and electrical infrastructure and distribution serving the spaces to be altered.
E. Work includes infection control and interim life safety.
F. Agencies Having Jurisdiction include (but are not limited to): Westchester Medical Center, NYS OGS, and NYS DOH.
G. The project is planned to be done in one phase.
H. Asbestos identification and removal will be done by Owner.

1.02 RELATED CONTRACTS

A. The Project consists of the following separate contracts:

General Construction Work	Project No. CMC 02956-GC
Mechanical Work	Project No. CMC 02956-M
Electrical Work	Project No. CMC 02956-E
Plumbing Work	Project No. CMC 02956-P

B. The suffix letter at the end of the project number distinguishes the separate Contracts. The Sections in Division 01 of the Specifications which have more than one suffix letter (such as this Section) are common to each related Contract.

1.03 CONCURRENT PROJECTS

A. Coordinate the work of this project, thru the Owner's Representative, to avoid conflicts with construction contracts.

1.04 SUBSTANTIAL AND PHYSICAL COMPLETION DATES

A. Substantially complete the Work within the # of calendar days after the contract notice to proceed as determined by WMC.

B. The approval of the Agreement by the Comptroller constitutes the filing of the Contract Documents as a public record and notice to the Contractor that a fully executed contract exists between the Contractor and the State.

1.05 CONTRACT AWARD SUBMITTALS

A. Submittal No. 1: Submit the CONTRACTOR'S LIST OF SUBCONTRACTORS-SUPPLIERS information required in SCHEDULES AND RECORDS Article in Specification Section 013200 not later than 15 days after approval of the Contract by the Comptroller.

B. Submittal No. 2: Submit the CONTRACTOR'S PROGRESS SCHEDULE information required in SCHEDULES AND RECORDS Article in Specification Section 013200 not later than 15 days after approval of the Contract by the Comptroller.

1.06 ITEMS NOT INCLUDED

A. The following items shown on the Drawings are not included in the Contract:
   1. Items indicated "NIC" (Not in Contract).
   2. Existing construction, except where such construction is to be removed, replaced, or altered.

1.07 CONFINED SPACE

A. Comply with confined space and permit-required confined space as defined in Title 29, Part 1910, Section 146 of the Code of Federal Regulations (29CFR 1910.146).

B. Comply with Safety Requirements for Confined Spaces (ANSI/ASSE Z117.1-2009).

1.08 OCCUPANCY

A. This is an occupied Facility. The building will be occupied and operational during execution of the Work. Ingress to and egress from the building shall be maintained at all times.

1.09 CONNECTION TO ELECTRICAL EQUIPMENT OR SYSTEMS

A. Contractor will not be allowed to tie into electrical equipment or systems until WMC/Facilities has reviewed and approved the connection.
   1. Submit written procedures thru the Owner's Representative to WMC/Facilities connection Work is proposed to be performed.
   2. After procedures have been approved, notify the Owner's Representative at least 3 working days prior to the connection Work so that arrangements can be made to have a WMC/Facilities Representative witness the work.

1.10 CONTRACTOR USE OF PREMISES

A. Work hours shall be as established by the Facility authorities thru the Owner's Representative.

B. Inform the Owner's Representative of work area access requirements. The Owner's Representative will coordinate and schedule the requirements with Facility staff to obtain and ensure timely availability of work areas.

C. Check in with the Facility Representative, as directed, at the beginning of each work day. Furnish information regarding where employees will be working during the day.

D. Comply with the Facility's Visitor Identification Policy. A copy of the current policy will be distributed at the initial job meeting.

E. The following items are not allowed on the Site or on Facility premises.
   1. Firearms, ammunition, weapons, and dangerous instruments (other than tools required for the Work).
   2. Alcoholic beverages and persons under the influence of same.
   3. Illegal controlled substances and persons under the influence of same.
   4. Cameras (except with written permission from the Owner's Representative).

F. Comply with Facility policies to smoking at the Site. (There is no smoking on the site.)

G. Routes of ingress and egress within the building to the location of the Work shall be as directed by the Owner's Representative.

H. Store materials and perform the Work so that pedestrian and vehicular traffic is not obstructed.

I. Do not diminish the level of life safety during performance of the Work.

J. (not used)

K. Utility Outages and Shutdowns: Do not interrupt utility services or branch services within the building except for the time required to make new connections. Arrange with the Owner's Representative for the time and duration of interruptions of services. Provide temporary services required to maintain building services at all times other than during scheduled interruptions.

L. Use of Existing Elevators:
   1. Elevators for transportation of workers and materials will be designated by the Owner's Representative. Arrange the time and duration of such use with the Owner's Representative. Do not exceed capacity of elevators. Provide padding or other protection for the car.

O. Be responsible and accountable for employees, suppliers, subcontractors and their employees, with regard to their use of the premises. Direct them to comply with the Facility Regulations and with the security and traffic regulations.

P. Furnish Facility authorities with a telephone number or method to contract the supervisor for the Work in case of an emergency after work hours, including weekends and holidays.

Q. Comply with applicable federal and State of New York Right-to-Know-Law provisions and supply copies of the appropriate Material Safety Data Sheets (MSDS) to the Owner's Representative, and to the Facility's Right-to-Know Information Officer.

R. Direct employees to be watchful for people in or near the work area where safety hazards may be present. Notify the Facility Safety/Security Department, if necessary, to remove them from the work area or Site.

S. Report fire and other emergency situations to the Facility Safety/Security Department immediately.

1.13 OPENINGS AND CHASES IN NEW CONSTRUCTION

Not Used.

1.14 SPRAYED-ON FIREPROOFING FOR NEW CONSTRUCTION

A. Construction Work Contract:

1. Notify the related contractors 5 working days prior to the application of fireproofing.
2. If related contractors fail to install hangers, clips, sleeves, and other items that will penetrate the fireproofing, the related contractors will be required to cut and repair the fireproofing at their own expense.

B. HVAC Work, Plumbing, Work, and Electrical Work Contracts:

1. Construction Work Contractor will give 5 working days' notice prior to application of fireproofing.

2. If hangers, clips, sleeves, and other items that will penetrate the fireproofing are not in place before application of the fireproofing by the Construction Work Contractor, all necessary cutting and repair fireproofing will be included in the Contract at no additional cost to the State.

1.15 REFERENCE SPECIFICATIONS AND STANDARDS

A. Comply with the requirements of the various specifications and standards referred to in these Specifications, except where they conflict with the requirements of these

Specifications. Such reference specifications and standards shall be the date of latest revision in effect at the time of receiving bids, unless the date is given.

1.16 LAYING OUT

A. Examine the Contract Documents thoroughly and promptly report any errors or discrepancies to the Owner's Representative before commencing the Work.

B. Lay out the Work in accordance with the Contract Documents.

1.17 SPECIAL INSPECTIONS

A. Special Inspections and tests are required by Chapter 17 of the Building Codes of New York State (BCNYS). Inspections & Testing Services will be provided by the Owner unless otherwise noted.

B. Contractors are responsible for notifying the Owner's Representative regarding individual inspections listed in the **NYS/OGS BDC Forms 406/406.1 STATEMENT OF SPECIAL INSPECTIONS.** Contractors shall cooperate with the inspections and testing agencies and sufficient notice and lead time (minimum 48 hours) must be allowed for inspection and testing to be performed.

C. Where deficiencies are identified, the contractor must take corrective actions to comply with the contract documents or remedy the deficiencies in accordance with Article 9 of the General Conditions.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 013100

PROJECT MEETINGS

PART 1 GENERAL

1.01 INITIAL JOB MEETING

A. The Owner's Representative will notify all parties concerned of the time and place of the initial job meeting. The meeting will be conducted by the Owner's Representative. The agenda will be based on the Format for Initial Job Meeting, Form BDC 311, a copy of which will be transmitted to the Contractor prior to the meeting. All items on the format, as they apply, will be discussed.

1. A copy of the Facility's current Visitor Identification Policy will be distributed.

B. The Owner's Representative will complete the project schedule based on the discussions and mutual agreements reach at the meeting.

1.02 PROJECT SCHEDULE DEFINITION MEETING

A. The Owner's Representative will notify all parties concerned of the time and place of the meeting (normally within 10 days after award of Contract). The meeting will be conducted by the Owner's Representative for the purpose of discussing all information required to develop the project schedule as outlined in Section 01320.

B. The Owner's Representative will be complete the project schedule based on the discussions and mutual agreements reached at the meeting.

1.03 WEEKLY JOB MEETINGS

A. Unless otherwise directed, job meetings will be held every week at a time and place agreed upon by the Owner's Representative, the Contractor, and the Facility Representative. Other interested parties may attend when needed, e.g., subcontractors and representatives from supplies, public utilities, and local

government. The meetings will be conducted by the Owner's Representative for the following purposes:

1. Review job progress, quality of Work, and approval and delivery of materials.

2. Identify and resolve problems which impede planned progress.

3. Coordinate the efforts of all concerned so that the project progresses on schedule to on time completion.

4. Maintain sound working relationships between the Contractors and the Owner's Representative, and mutual understanding of the project requirements.

5. Maintain sound working procedures.

1.04 PRE-INSTALLATION/COORDINATION MEETINGS

A. Pre-installation meetings will be held to review the specifications, drawings, and approved submittals in preparation for start of a particular activity.

B. The meetings shall be attended by the Owner's Representative, a Design Representative and the Contractor's Representative including installer and representatives of manufactures & fabricators involved in or affected by the installation and its coordination with other materials/trades.

C. The Owner's Representative shall schedule the meetings prior to the start of the work. The goal of these meetings is to ensure the quality of construction and to maintain the schedule.

1.05 ATTENDANCE

A. A Contractor's Representative shall be required to attend all meetings scheduled by the Owner's Representative.

B. The Contractor's Representative shall be a competent supervisor familiar with the work and have authority to act for the Contractor.

C. If the Contractor's Representative fails to attend 2 scheduled meetings without prior approval, the contractor will be directed to replace the current Contractor Representative.

Further incidents of non-attendance by the Contractor's Representative, will form the basis for review of the Contractor's responsible bidder status.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 013200

PROJECT SCHEDULE

PART 1 GENERAL

1.01 RELATED REQUIREMENTS AND INFORMATION SPECIFIED ELSEWHERE

A. Project Meetings: Section 01 31 00.

1.02 DEVELOPMENT OF THE PROJECT SCHEDULE

A. The Owner's Representative will schedule the Project Schedule Definition Meeting as outlined in Section 01310. The meeting will include presentation of the detailed Preliminary Project Schedule previously summarized in the bidding documents. The discussions and mutual agreements reach at this meeting will form the basis for developing the CPM baseline network which will be defined as the Project Schedule and will be used for coordinating, scheduling, and monitoring the Work of all related contracts.

B. Changes proposed by the Contractors which may alter the preliminary CPM baseline network shall include identification of activities and tasks including activity codes, activity descriptions, specification section numbers related to each activity, durations, schedule logic, and other information required to modify the computerized schedule.

C. The Owner's Representative will complete the Project Schedule and present it to the Contractors for review and acceptance.

D. Any Contractor who fails to furnish information required for completion of the Project Schedule, or who fails to accept the defined Project Schedule within 10 days of final schedule presentation, will be required to provide all resources necessary to execute the Project Schedule as developed and defined by the Owner's Representative.

1.03 UPDATING THE PROJECT SCHEDULE

A. The project meetings will be used for presenting the update Project Schedule and determining the status of construction activities. At each meeting the Owner's Representative will furnish to the Contractors schedule status reports to be used for indication the anticipated completion date of current activities, analyzing the progress of

construction, and identifying the Contractor or Contractors who are not progressing their Work as scheduled.

B. Furnish all schedule information requested by the Owner's Representative. Any Contractor who fails to furnish this information within the specified time period will be required to provide all resources necessary to execute the Project Scheduled developed by the Owner's Representative.

1.04 MAINTAINING Schedule

A. Perform the Work in accordance with the Project Schedule and provide resources necessary to maintain progress of activities as scheduled so that no delays are caused to other Contractor engaged in the Work.

B. Should any Contractor fail to maintain progress according to schedule or cause delay to another Contractor, that Contractor shall provide such additional manpower, equipment, additional shifts, or other measures as directed to bring the operations back on schedule.

1.05 SCHEDULE RELATED REPORTING

A. Application for Payment: Prepare Standard AIA forms and support documentation monthly. Show costs in support of activities progressed in the Project Schedule status updates. Percentage completion amounts must reflect accepted work in place as agreed upon by the Director's Representative and documented in project meeting schedule status reports.

B. Certified Payrolls and Labor Resource and Crew Utilization Reports: Submit weekly to the Owner's Representative.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (not Used)

END OF SECTION

SECTION 013300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. The role of the Contractor is to look at overall schedule and review the Submittal prior to submitting to the A/E, to make sure that the Submittal in general is complete enough and relevant enough to allow the A/E to review it. Contractor to add stamp to each submittal indicating that the above review has occurred prior to submitting to the A/E.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Contractor’s responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Contractor’s responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and Contractor and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action, informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's and Contractor’s final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled dates for installation.
    i. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

    a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    b. Contractor shall execute a data licensing agreement in the form of an Agreement form acceptable to the Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Contractor reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow (10) Business days for initial review of each submittal.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow (10) Business days for review of each resubmittal.

D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Include the following information for processing and recording action taken:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Name of subcontractor.
g. Name of supplier.
h. Name of manufacturer.
i. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

j. Number and title of appropriate Specification Section.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Other necessary identification.

E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Contractor.
4. Include the following information on an inserted cover sheet:

a. Project name.
b. Date.
c. Name and address of Architect.

d. Name of Construction Manager.
e. Name of Contractor.
f. Name of firm or entity that prepared submittal.
g. Name of subcontractor.
h. Name of supplier.
i. Name of manufacturer.
j. Number and title of appropriate Specification Section.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Related physical samples submitted directly.
n. Other necessary identification.

5. Include the following information as keywords in the electronic file metadata:

a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

F. Options: Identify options requiring selection by the Architect.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect and Contractor observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. .

1. Transmittal Form: Use AIA Document G810.
2. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Specification Section number and title.
i. Indication of full or partial submittal.
j. Drawing number and detail references, as appropriate.
k. Transmittal number**,** and numbered consecutively.
l. Submittal and transmittal distribution record.
m. Remarks.
n. Signature of transmitter.

3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and Contractor on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's and Contractor's action stamp.

K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's and Contractor's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.

6. Submit Product Data in the following format:

    a. PDF electronic file.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based upon Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Sheet Size: As required for legibility.
3. Submit Shop Drawings in the following format:

    a. PDF electronic file.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:

    a. Generic description of Sample.
    b. Product name and name of manufacturer.
    c. Sample source.
    d. Number and title of applicable Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit (3) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit (3) sets of Samples.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least (3) sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

    a. PDF electronic file.

F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."

H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Submit subcontract list in the following format:

    a. PDF electronic file.

J. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

R. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it.

C. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 013533 – INFECTION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes policies and procedures required of the Contractor to prevent transmission of infectious agents, dust, particles and other airborne particulate to vulnerable patient populations, health care workers and visitors within the Hospital and clinical environments.

1.3 RELATED REQUIREMENTS:

A. Document 01 3523 - Owner Safety Requirements

B. Document 01 5000 - Temporary Facilities and Controls; for additional procedures and construction of temporary barriers.

C. Division 15 Sections for cleaning heating, ventilation and air-conditioning systems and ductwork prior to operation.

1.4 DEFINITIONS

A. Aspergillus: A thermotolerant fungus that causes significant disease among immuno-compromised hosts that will disseminate to other organs including the skin and the brain. These fungi are ubiquitous, found in soil, water, dust and decaying material. Aspergillus have been cultured from unfiltered air, ventilation systems, contaminated dust dislodged during hospital renovation and construction, horizontal surfaces, food, and ornamental plants. Aspergillus spores are easily suspended in the air and survive for prolonged periods. Because of their size, they are easily inhaled, which can lead to invasive infection of both the upper and lower respiratory tracts in a susceptible host.

B. Biocide: A physical or chemical agent that is capable of killing microorganisms.

C. Immunocompromised: A condition where a patient's immune response is reduced or absent. Because defense mechanisms are limited in immunocompromised patients, they are susceptible to infections by microorganisms that are present everywhere, but do not cause disease in healthy people.

D. Hospital Acquired: An infection that is acquired in a hospital or as a result of medical care.

E. Negative Pressure: The relative air pressure difference between two areas in a healthcare and clinical facilities. A space that is at negative pressure has a lower pressure than adjacent areas, ensuring that any directional air movement is from the clean air environment into the contained area and preventing contaminated air from escaping into adjacent rooms or areas through doors, openings and cracks.

F. HEPA: An acronym that stands for high efficiency particulate air. A HEPA filter is an air filter capable of capturing 99.97% of particles as small as .3 microns.

G. Multi-Stage Filtering: Successive, filtering that prevents early loading of filters with contaminants and thereby delaying reduced airflow. Typical multi-stage filters might consist of a large particulate filter (10 microns), a smaller particulate filter (5 microns), an activated charcoal filter (odors) and a HEPA filter (.3 microns).

H. Negative Pressure Machine: Freestanding, portable device that creates a negative air pressure within a space. It does so by removing air via flexible ductwork from the containment area. The units can also be placed remotely from the containment area and use ductwork to remove air from the controlled environment.

I. Portable Air Scrubber: Freestanding, portable device that removes airborne contaminants by recirculating air through a HEPA filter. Portable air scrubbers can also serve as negative pressure machines by exhausting the recirculated air from the containment area.

J. Containment: The process of isolating a contaminated area from the rest of the facility. Depending on the work to be done and the equipment required, airlocks, pass throughs, and equipment rooms may be necessary. Full containment always requires that negative pressure be maintained inside the containment area.
   1. Containment Requiring Activities include, but are not limited to the following:
      a. Demolition and removal of walls, floors, ceilings and other building finish materials.
      b. Demolition of plumbing, mechanical and electrical systems and equipment.
      c. Finish operations such as sanding, painting and application of special surface coatings.
      d. All routine construction activity that can generate dust.
      e. Sitework operations.
   2. Source containment can also be used with localized negative pressure if a very small area is involved. A small piece of plastic sheet can be taped around the area to be removed. A small HEPA vacuum is used for this purpose by inserting the inlet nozzle inside this small containment to create a negative pressure and to vacuum up released particles.

K. Containment Area: The construction activity area, adjacent staging and storage areas, passages for construction personnel to access the project site and delivery and removal of supplies and waste. It includes the entire volume of the project area including ceilings spaces above and adjacent to the construction area. Containment areas are determined by the Construction Project Manager, the Hospital's ICRA Committee, and as indicated on the Drawings.

L. Pressure Differential: The difference in magnitude between a reference pressure and a variable pressure.

M. Air changes per hour is equal to the air filtered (in cubic feet) in one hour divided by the containment area size (in cubic feet), or

$$\text{Air Changes per Hour (AC/H)} = \frac{\text{Cubic Feet of Air filtered in 1 Hour}}{\text{Containment Area Size in Cubic Feet}}$$

N. Protection Area: The designated project limits, hospital and clinical areas adjacent to containment area, either occupied or used for passage and areas connected to construction areas by mechanical system intake, exhaust and ductwork. Protection areas are determined by the Construction Project Manager and the Hospital's Infection Control Committee as indicated on the Drawings.

O. Minor Ceiling Access: Removal of one ceiling or access panels for visual observation in 50'-0", minor adjustments or other activities that do not disturb dust. All acoustical and access panels shall be closed immediately upon leaving the worksite.

P. Major Ceiling Access: Removal of ceiling panels or systems that is not defined as "minor".

Q. Thorough Cleaning (Construction Clean): Cleaning of surfaces that become exposed to dust shall be accomplished by the use of either a HEPA-filtered vacuum cleaner or a wet mop.

R. Terminal Cleaning: Completed by Hospital Environmental Service Staff after construction complete and space turned over for occupance.

S. Infection Control Risk Assessment (ICRA): A broad, long-range involvement of a Hospital's infection control/epidemiology leadership and safety staff, to assess the risk to patients and the Hospital environment to airborne contamination.

1.5 POLICY

A. The intent of this policy is to minimize Hospital Acquired Infections (HAI) in patients that may arise as a result of exposure to organisms released into the environment during construction and renovation activities. Controlling the dispersal of airborne or waterborne infectious agents concealed within building components is critical in all Spectrum facilities.

B. Patient Care Objectives: All construction and renovation activities shall be defined and managed in such a way that occupants' exposure to dust, moisture and their accompanying

hazards is limited.

1. Aspergillosis and related nosocomial fungal infections are caused through inhalation by immunocompromised patients of aspergillus spores, or other related spores, that can be present in the construction environment. The spores are known to be prolifically present in construction dust, debris and earthwork excavation dust. Outbreaks are associated with unfiltered air, contaminated ventilation systems at intake and exhaust ducts, and dust that is dislodged by renovation and construction. Control of construction dust, debris and excavation dust is imperative to help prevent outbreaks of aspergillosis or related nosocomial fungal infections in immunocompromised patients.
2. Inhalation of aspergillus spores or other fungal spores by immunocompromised patients can lead to serious complications and death.
3. Airborne contaminant control is critical in all areas. Contractor shall limit dissemination of airborne contaminants produced by construction-related activities, in order to provide protection of immunocompromised patients, other patients, staff, diagnostic operations and sensitive procedures and medical equipment from possible undesirable effects of exposure to such contaminants.
4. Dust in ceilings and construction debris contains fungus spores. Construction activities causing disturbance of existing dust, or creating new dust, or other airborne contaminants, must be conducted in tight enclosures cutting off any flow of particles into patient areas.
5. Ceilings and walls in protected areas and other areas within Hospital and clinical area as indicated on Drawings must be secure from airborne transmissions at all times. If access into the ceiling in occupied areas is required, procedures described within this Section shall be followed.
6. Enclosed and wiped clean carts must be used when transporting construction debris and materials throughout the environment. The Construction Project Manager and Hospital ICRA Committee shall approve the transportation path and destination terminus prior to commencing the project.

1.6 PROCEDURES

A. The Owner's Representative (CPM) in conjunction with the Hospital's ICRA Committee will:
   1. Determine the infection control project classification using the matrices located below.
   2. Coordinate the relocation of affected patients and pedestrian traffic routes to areas where there is less potential for exposure to airborne contaminants with the responsible departments.
   3. Coordinate the preparation of the project area, including the removal of medical supplies, waste, and equipment, prior to the commencement of project activities with the responsible departments.

B. Infection Control Risk Assessment (ICRA) Guidelines
   1. STEP 1: Identify the Construction Project Activity Type (Types A-D) by selecting the appropriate construction activity type from the table below. Construction activity type is determined by the amount of dust that is generated, the duration of the activity and the involvement with HVAC systems.

Construction Project Activity by Type (A-D)	
Type A	Inspection and Non-Invasive Activities. Includes, but is not limited to: removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet painting (but not sanding) Inspection of wallcovering, electrical trim work, minor plumbing, and activities that do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
Type B	Small scale, short duration activities which create minimal dust Includes, but is not limited to: installation of data, telephone and computer cabling access to chase spaces cutting of walls or ceiling where dust migration can be controlled

Type C	Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies Includes, but is not limited to: sanding of walls for painting or wall covering removal of floorcoverings, ceiling tiles and casework new wall construction minor duct work or electrical work above ceilings major cabling activities any activity that cannot be completed within a single workshift.
Type D	Major demolition and construction projects. Includes, but is not limited to: activities which require consecutive work shifts new construction requires heavy demolition or removal of complete cabling system any activity that requires temporary partitions

C. STEP 2: Identify the Patient Risk Group that will be affected by selecting the appropriate Patient Risk Group from the table below. The Patient Risk Groups defined are based on project location and occupancy. If more than one risk group will be affected, select the higher risk group. For all construction classes, patients must be removed from the room while work is performed.

Patient Risk Group			
Low Risk	Medium Risk	High Risk	Critical Risk
Infrastructure (electrical closets, mechanical rooms) Office areas Public Areas Outpatient Clinics Shell Space	Burn Clinic Cardiology Echocardiography Endoscopy Nuclear Medicine Physical Therapy Radiation Oncology Radiology/CT/MRI Respiratory Therapy Occupational Therapy	Emergency Room Kitchen / Cafeteria Labor & Delivery Laboratories (specimen) Medical and Surgical Units Newborn Nursery Outpatient Surgery Pediatrics Pharmacy Post Anesthesia Care Unit Progressive Care Inpatient Rehab Services Rehab Unit Long Term Care Unit / Skilled Nursing Facility (SNF)	Any area caring for immunocompromised patients Burn Unit Cardiac Cath Lab Central Sterile Supply Dialysis Intensive Care Units Interventional Radiology Negative pressure isolation rooms (including Bronchoscopy Suites) Oncology / BMT Operating rooms including C-section rooms Pediatric Sedation Sterile Processing

1. Note: If an area requiring work is located within an area listed as a higher patient risk group it will be treated as if if is the higher patient risk group (e.g. a mechanical closet located within an operating room area.)

D. STEP 3: Match the Patient Risk Group (Low (L), Medium (M), High (H), Critical Risk (X)) with the Construction Project Type (A, B, C, D) to find the Class of Precautions (I – IV). Using the Construction Activity Type and the Patient Risk Group selected from the tables above, use the infection control matrix below to determine Construction Classification (Class). Construction Classification (Class) determines the procedures to be followed during construction and

renovation projects.

Patient Risk Group / Construction Project Type Comparison				
Patient Risk Group	TYPE A	TYPE B	TYPE C	TYPE D
Low Risk Group	I	II	II	III / IV
Medium Risk Group	I	II	III	IV
High Risk Group	I / II	II	III / IV	IV
Critical Risk Group	II	III / IV	III / IV	IV

1. Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that Class III or Class IV control procedures are necessary.

E. STEP 4: Description of Required Infection Control Precautions by Class. Implement the appropriate Construction Guideline based on the project classification selected from the Construction Activity matrix above (STEP 3). Construction Classification (Class) Guidelines are procedures to control release(s) of airborne contaminants resulting from construction, demolition, or renovation activities.

Description of Required Infection Control Precautions by Class		
During Project Construction		Upon Project Completion
Class I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection. 3. If more than once ceiling tile is removed for inspection in a non-critical area, a containment unit must be used. 4. No particulate testing required.	1. Clean work area upon completion of task.
Class II	1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents with filter media. 5. Place dust mat at entrance and exit of work area 6. Remove or isolate HVAC system in areas where work is being performed. 7. No particulate testing required.	1. Wipe work surfaces with cleaner/disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Remove isolation of HVAC systems in areas where work is being performed.

Class III	1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system. Block supply vents and filter return ducts. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Document and Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid. 6. Minimum particulate testing required is baseline, midway, and at end of project.	1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Department. 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with cleaner /disinfectant. 5. Remove isolation of HVAC systems in areas where work is being performed. 6. Conduct final particulate testing
Class IV	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Document and Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures appropriately. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 7. Minimum particulate testing required is baseline, midway, and at end of project.	1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Dept. 2. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 3. Contain construction waste before transport in tightly covered containers. 4. Cover transport receptacles or carts. Tape covering unless solid lid. 5. Vacuum work area with HEPA filtered vacuums. 6. Wet mop area with cleaner /disinfectant. 7. Remove isolation of HVAC systems in areas where work is being performed. 8. Conduct final particulate testing

1.7 PERFORMANCE REQUIREMENTS

A. Owner's Representative (CPM) Responsibilities:
   1. Determine that the Containment and Protection Areas are properly defined and adequately enclosed by the Contractor.
   2. Issue a Statement of Requirements in both graphic and written form to communicate the above, based upon an evaluation of the construction area and the impact of the project on patient care.
   3. Approve all enclosures constructed by the Contractor.

B. Owner's Responsibilities:
   1. Assist Owner's Representative to determine the Containment and Protection Areas.
   2. Coordinate access to Infection Prevention.

C. Contractor's Responsibilities:
   1. Comply with applicable codes and referenced controls using installation procedures and methods that satisfy code requirements and referenced infection control procedures.
   2. Determine specific means and methods of achieving and maintaining control of airborne contaminants during construction.
   3. Propose work plan and procedures for control of airborne contaminants.
   4. Submit Contractor's work plan for control of contamination for review in advance of performing any construction activities. Follow procedures established for product shop drawing submittals.
      a. Owner's Representative and Architect shall review work Plan Submittal for general compliance.
      b. Contractor shall possess a signed copy of the reviewed submittal prior to proceeding with the work.
   5. Conform to notification requirements in Quality Assurance Article.
   6. Provide and maintain all dustproof enclosures, measurement devices, warning signs and warning lighting to protect the patients, Hospital and clinical areas, staff and public. Contractor shall remain responsible for compliance with all contamination control requirements.
   7. Verify that all construction personnel have reviewed infection control procedures by using sign-in method. Provide a copy of attendees.

1.8 PRECONSTRUCTION CONFERENCE

A. Pre-Construction Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to Infection Control Risk Assessment (ICRA) including, but not limited to, the following:
   1. Identify Infection Control Risk Assessment.
   2. Review infection control policy.
   3. Review infection control procedures.

B. Attendees shall include the Owner's Representative, the Hospital's Infection Control Coordinator, the Architect, the Construction Manager, the Contractor the major Subcontractors, and any other parties involved with the project.

1.9 SUBMITTALS

A. Progress Schedule: Submit work and procedure schedules for temporary containment construction. Incorporate infection control milestones within the master project schedule.

B. Work Plan: Submit drawings and construction details of temporary barriers, descriptions of procedures to be used to achieve and maintain control of construction- related airborne contaminants.

C. Product Data: Include standard specifications, material descriptions, furnished specialties and accessories, rated capacities and capabilities of individual components for achieving containment.

D. Special Reports:
   1. Provide written report of Infection Control procedures, including locations, exit routes, details of dust barriers, and means of creating negative pressure prior to commencing the project.
   2. Provide written report confirming specified air velocity whenever enclosure is erected or modified in designated Protection Area.

E. All reports, work plans, and other supporting documentation should be submitted and reviewed by Hospital ICRA staff.

1.10 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified for testing indicated.

B. Testing: Owner will engage a qualified independent testing agency to test air quality and pressure for compliance with specified requirements for performance and test methods.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Provide products and materials that comply with stated requirements for each type of products or materials specified.

B. Products identified below are recommended as appropriate to the task at hand. Other manufacturers than those listed may be submitted for approval, but it is the Contractor's responsibility to provide effective documentation that adequately supports a substitute product or material.

2.2 INFECTION CONTROL PRODUCTS

A. Adhesive-Faced Contamination Control Mats: Sanitary walk-off mat consisting of multi-layered, disposable, 2 mil, non-allergenic, non-odorous, polyethylene sheets with non-drying solid adhesive and anti-microbial germicide. Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Floor Mats; Clean Room Sticky Mats
   2. Controlled Environment Equipment Corporation; Cleanline® Medical Mats.
   3. Liberty Industries, Inc.; Tacky Mat® 800030
   4. Stickymat USA; Tacky Mat.
   5. Texwipe; CleanStep® Adhesive Contamination Control Mats

B. Modular Temporary Enclosure Panels: Aluminum framed and faced height adjustable panels and accessories to create complete barriers for construction projects.
   1. "STARC Systems" www.stratcsystems.com

C. Portable Enclosures: Construct a temporary enclosure whenever work is performed outside of the containment area. Provide an enclosure of polyethylene sheet described below, enclosing ladder and sealing off opening at the ceiling system, or provide a prefabricated enclosure unit.
   1. Portable Pre-Fabricated Environmental Enclosure: A temporary enclosure for work in sterile or patient environment outside of the Containment Area. A heavy-duty vinyl enclosure and adjustable, spring-loaded top frame to accommodate variabilities in ceiling height; provide ceiling mechanism for snug fit that will not damage ceiling panels. Furnish with inspection window, pressure differential porthole for a HEPA-filtered vacuum device capable of 300-800 CFM and manometer.
      a. Clean Work Booth, Inc. www.cleanworkbooth.com (This is the standard unit Spectrum uses)
      b. Fiberlock Technologies, Inc.; Kontrol Kube®.
      c. Mintie Technologies, Inc.; ECU Ceiling Cavity™.
      d. ZipWall LLC; Zipwall®.

D. Polyethylene Sheet: Provide 6 mil, internally reinforced polyethylene laminate, fire- retardant sheet, NFPA-approved, sealed with fire-retardant tape at joints and penetrations above the ceiling.
   1. Reef Industries, Inc.; Griffolyn® Type 55 FR.

2. Raven Industries; DURA-SKRIM® 2FR or 10FR.

2.3 ACCESSORIES

A. Protective Clothing: The Owner will provide disposable paper jumpsuits or reusable, fabric coveralls, head, and shoe coverings for use by construction personnel outside or inside of the Containment Area.

B. Respiratory Gear: Provide respiratory gear as required by OSHA regulation 29 CFR 1926 (Construction Safety Regulations).

2.4 EQUIPMENT

A. Portable Air Scrubbers and Negative Air Machines:
1. Product[s]: Multi-filtered, including 99.9% efficient HEPA filter, variable-speed motor, static pressure-monitored, equipped with electrical or mechanical lockout to prevent fan from operating without a HEPA filter, powered mechanical equipment utilized to create a dust-free environment. Subject to compliance with infection control requirements, provide one of the following:
   a. Abatement Technologies, Inc.; HEPA-AIRE® Portable Air Scrubber.
   b. Micro-Trap Inc.; Micro Trap™ 2000 Negative Air Filtration Unit.
   c. Mintie Technologies, Inc.; 2000V Negative Air Machine.
   d. Omnitec Design, Inc.; Omniaire OA2000V HEPA Negative Air Machine.

B. Hospital may provide the HEPA-filtered vacuum for Contractor use during the project.

C. HEPA-Filtered Vacuum Machine:
1. Product[s]: Multi-stage, 99.9% efficient HEPA filtration system, grounded, interference suppressed, 110/120V or 220/240V motor, minimum10-gallon, minimum 500-1000 CFM capacity, powered mechanical equipment utilized to negatively pressurize small temporary dust enclosures to create a dust-free environment or in use to clean surfaces or construction personnel. Subject to compliance with infection control requirements, provide one of the following:
2. Festool; CT Dust Extractor, Cleantex CT 48 HEPA (12.7 gal).
3. Nikro Industries, Inc.; HEPA Vacuum (Dry), Model PD15110 (15 gal).
4. Dustless® Technologies; Dustless HEPA Vacuum (16-gal).

D. Air Pressure Monitor:
1. Product[s]: Differential switch/gauge to monitor differential pressure between the containment area and the protection area. Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background and front recalibration adjustment with a range of plus/minus 0- to .50-inches water gauge and high-low adjustable set points. Subject to compliance with infection control requirements, provide a product comparable to the following:
   a. Abatement Technologies, Inc.; HEPA-CARE®
   b. Dwyer Instruments, Inc.; Model #3000MR-0.
   c. OMEGA; DPG300
2. Install the differential pressure switch/gauge in a NEMA-rated enclosure. Provide all necessary power wiring, transformers and relays to operate the system. Provide a switch that will enable activation of audio, visual, or both alarms that activates upon sensing pressure differences beyond the range set points. Provide a manual reset gauge after an alarm condition.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine containment area and protection area, with Owner Representative (CPM) and Infection present, for compliance with Infection Control requirements.
1. For the record, prepare written report, endorsed by Owner Representative, listing conditions detrimental to Infection Control performance.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

a. Notify the Owner's Representative according to time line requirements identified previously before commencing work.

3.2 MONITORING

A. Before commencing any demolition or construction in occupied areas, a complete review of all airborne contaminant control policies shall be conducted. A checklist shall be completed and signed by the Construction Project Manger, Infection Preventionist and the Contractor, confirming that the area is ready for work to begin.

B. Owner will monitor conditions in the vicinity of project in Protection Areas. Such areas are identified by the Owner's Representative and as indicated on drawings. Whenever unsafe conditions are observed, Contractor will be notified to correct conditions immediately to avoid work stoppage.
   1. All work shall be stopped immediately whenever a hazardous containment control deficiency exists on the project.
   2. The Contractor shall take immediate action to correct all deficiencies.

3.3 PROTECTION

A. Contractor shall install dust proof enclosures for work as directed above, as directed by the Owner's Representative, as indicated on the Drawings and when required to protect areas occupied by the Owner from dust, debris, and damage.

B. Provide a temporary work surface to provide a safe working platform and protect the ceiling and the spaces below from falling objects and materials. Construction must be conducted in tight enclosures cutting off any flow of dust particles into patient areas.
   1. Airborne contaminant control requirements: Floor to structure, airtight enclosures, drywall barriers, using tape and foam padding to seal all joints and penetrations.
   2. Keep enclosure door closed at all times.
   3. Traffic between Containment Area and open areas shall be kept to a minimum.
   4. Transport materials and refuse into an area from an external site without violating patient care areas by transporting in covered containers.
   5. Provide negative pressure in construction area.
   6. Provide adequate forced ventilation of enclosed areas to cure installed materials, to prevent excessive humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
   7. Ductwork Dust Caps: Block off all existing ventilation ducts within the construction area. Method of capping ducts shall be dust-tight and withstand airflow pressures.

C. Dust Proof Enclosures:
   1. Full height, noncombustible construction with minimum 5/8" fire-rated gypsum board both sides with 3-1/2 inch R-11 insulation batts to reduce noise UL Approved design for any 1-hour rated enclosure if required by authorities with jurisdiction. Use tape to tightly seal top, bottom, penetrations and seams, to prevent spread of dust to occupied areas, including above ceiling. Secure all tape with spray adhesive. Dust proof enclosures adjacent to or in public areas shall be taped and painted on the side exposed to public view.
   2. Enclosure Doors: 4'-0" minimum width, unless shown otherwise, solid core wood with metal frame and hardware, closer and tightly weatherstripped to prevent flow of dust. Locate as indicated on drawing and swing out of the construction area. Keep enclosures locked outside of working hours. Coordinate with the Owner for access.
   3. Install disposable, multi-layered tacky floor mats on both sides of construction entrance prior to commencing demolition or construction. Remove old tacky surface as needed to prevent tracking, daily as minimum.
   4. Obtain Owner's approval of exact location and details of enclosure construction.
   5. Materials for enclosure shall be precut in unoccupied areas before delivering to project site. No explosive or pneumatic drive fasteners permitted, unless authorized by Owner.

6. Provide entrance vestibules (antechambers) as described. Provide all floor mats inside vestibule. Sticky mat should be adjacent to door, with dry mat and then wet mat as you proceed into construction area.

D. Enclosure outside of work area (including spaces above ceilings): Whenever work is necessary outside of the construction enclosures (containment area), the space where work is being done, including ladders, shall be contained within a full-height portable enclosure. At Contractor's option, a prefabricated unit may be used.
   1. All work performed outside the construction enclosure shown on drawings, including all work in corridors and lobbies shall be performed outside of normal working hours and shall be scheduled in advance with Owner, except where specified otherwise.
   2. At no time shall any construction equipment or material be stored outside the construction enclosure.
   3. Any dust tracked outside of construction area shall be cleaned up immediately. Contractor shall have the necessary personnel and equipment (HEPA-filtered vacuum, dust and wet mops, brooms, and clean wiping cloths) to keep adjacent occupied areas clean at all times.

E. Power and Lighting: Provide sufficient temporary lighting and power ventilating equipment to ensure proper workmanship and safety.

F. Access Provisions: Provide ramps, stairs, ladders and similar temporary access elements as reasonably required to perform the work and facilitate its inspection during installation.

G. Airborne dust generation of significant quantities of dust will not be tolerated. Clean the work area prior to starting work to minimize existing dust becoming airborne during construction. Provide drop cloths and dust partitions as necessary to contain dust and debris generated by the work.

H. Demolition material, dust and dirt shall be removed in covered, tightly sealed, rubber tired, polyethylene dump carts. Containers shall be fitted with clean polyethylene covers, completely sealed at perimeter by wire tying or taping. Before leaving area, all containers shall be wiped clean with biocide to prevent tracking of dust. Provide debris chutes if required.

I. If work is being performed above an accessible ceiling and if work must be performed while the space below is occupied, spray top of ceiling panels to be removed and surrounding affected panels, with fine detergent/water mist to settle dust prior to removal.

J. A portable plastic fabric tunnel or a polyethylene enclosure for larger openings shall be used for each single ceiling access outside of the Containment Area. The enclosure's opening shall have a 3-foot overlap of polyethylene to decrease risk of airborne dust. The portable plastic fabric tunnel, or portable enclosure, shall remain in place until the ceiling is secured (all accesses closed). In patient care areas, the apparatus (tunnel or enclosure) shall be dismantled and access panels replaced or remodeling of access completed at the end of each day.

K. If the contractor needs to crawl about pipes, ducts, or other building infrastructure to investigate a condition, the Contractor shall use additional procedures, (e.g. put on a mask, disposable coverall and disposable shoe covers) before going into the access. The surfaces that will be disturbed shall be vacuumed with a HEPA-filtered vacuum before proceeding. Afterwards the contractor shall strip off the coverall, and shoe covers carefully, turning the coverall "inside-out" and deposit the mask, coverall, and shoe covers into a plastic trash bag inside the enclosure. This plastic trash bag shall be secured (tied off) and discarded as directed by Owner's Representative and may not be discarded within any patient care area.

L. Exercise caution when handling fluids, or piping systems, in the space above ceilings and other Hospital or clinical operations. When working with fluids, provide a watertight barrier beneath the work area to catch and retain all spillage before it reaches the ceiling below.

M. Water leaks must be cleaned up and repaired as soon as possible, but within 48 hours to prevent mold proliferation in floor and wall coverings, ceiling panels and cabinetry in patient care areas. If cleanup and repair are delayed more than 48 hours after the water leak, the involved materials must be assumed to contain fungi and handled accordingly. Use of a moisture meter to detect water penetration of walls should be used whenever possible to guide decision-making. Moisture meter testing to be performed by Owner. If the wall or other component does not have less than 20% moisture content more than 48 hours after water penetration, it shall be removed.

N. Contractor is responsible for determining when a dust proof enclosure is required to protect any adjoining area; however, the Contractor shall provide a dust proof enclosure where indicated and whenever requested by the Owner's Representative. Take all necessary precautions to protect the people and spaces below from injury or damage due to Contractor's operations.

O. Notify department manager so that patient room doors near ceiling work will be kept closed while the work is in progress.

3.4 CONTAINMENT AREA

A. Maintain levels of airborne contaminants within Containment Area and Protective Area limits as defined by the Owner's Representative and Infection Control Risk Manager.

B. Portable Air Scrubbers and Negative air machines shall remove airflow from construction area at not less than 100 FPM at enclosure entrances with all doors fully open. As an alternative, provide adequate exhaust air volume to provide 6 air changes per hour.

C. Dust Control: The Contractor shall take appropriate steps throughout the term of the Project to prevent airborne dust due to work under this contract. Water shall be applied wherever practical to settle and hold dust to a minimum, particularly during demolition and moving of materials. Care must be taken to prevent the accumulation of standing water or the saturation of any materials. No chemical palliatives shall be used without permission of the Owner's Representative.
   1. Spray surfaces with water during dust-producing interior demolition activities. Hard surface floors in work area, adjacent hallways and passage areas require vacuuming with HEPA-filtered vacuum cleaners and frequent wet-mopping during demolition and construction; protect adjacent carpeted areas with plastic and plywood and vacuum with HEPA-filtered vacuum cleaners.
   2. Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent airborne dust from dispersing into atmosphere.
   3. Any dust tracked outside enclosure shall be removed immediately, using HEPA-filtered vacuum.
   4. All cleaning outside enclosure shall be by HEPA-filtered vacuum or other approved method.

D. The following procedure shall be implemented when construction personnel are required to pass through a Protected Area to enter the Containment Area:
   1. Provide airlock entry vestibules to dustproof enclosures when shown on Drawings or required by Owner's Representative.
   2. Construction personnel shall wear protective clothing when passing through the Protective Area or when directed by the Owner's Representative. The protective clothing shall be removed in the airlock vestibule prior to entering the Containment Area and stored for reuse.
      a. When exiting the Containment Area the protective clothing shall again be worn when passing through the Protective Area.

E. Construction Personnel: Instruct personnel to refrain from tracking dust into adjacent Hospital or clinical areas or opening windows or doors allowing airborne contaminants into the adjacent Hospital or clinical areas.

F. Exterior Work: Direct exhaust from equipment away from building air intakes, maintain minimum distance equal to 25'-0"; assure that filters on building air intakes are operational and protected from excessive amounts of airborne contaminants.

G. Any ceiling panels opened for investigation beyond sealed areas shall be replaced immediately when unattended or covered with an appropriate temporary barrier.

H. Removal of construction barriers and ceiling protection shall be done carefully.

3.5 EQUIPMENT

A. Connect portable air scrubbers and negative air machines to emergency power and run continuously.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of completed phases of the work shall take place in successive stages, in areas of extent and using methods described in Quality Assurance article.
Do not proceed with removal or construction of each enclosure for the next area until test results for previously completed phases of the work show compliance with requirements. Owner's Representative is satisfied that work is completed and clean up procedure has been performed.

C. Repair or replace construction enclosures where test results indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of repaired or replaced work with specified requirements.

3.7 CLEANING

A. Provide thorough cleaning of all surfaces that become exposed to dust each day. Thoroughly clean each temporary access when work is completed or at the end of each work shift, using approved methods.

B. Provide a final thorough construction cleaning of area before turning space over to Owner for final cleaning.

C. Final cleaning of construction (to medically clean standards) shall be performed by the Owner's own housekeeping forces.

3.8 ENFORCEMENT

A. Failure to maintain containment areas will result in issuance of a written warning. If the situation is not corrected within (8) eight hours of receipt of warning, Owner will have cause to stop the work as provided in the General Conditions.
1. Failure of Contractor to correct deficiencies in containment will result in corrective action taken by Owner and all costs deducted from the Contractor.

B. The Owner's Representative will perform periodic inspections to determine compliance with infection control procedures. Written documentation shall be filed as part of the project documentation. Photographs may be taken to document work site conditions.

END OF SECTION 013533

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Note that in addition to the typical temporary facilities on an interior renovation project such as this, note the following additional special aspects of the project which require temporary facilities and controls:

1. N.A.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

D. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage

provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.

1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

D. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of the work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air filtration system discharge.
4. Other dust-control measures.
5. Waste management plan.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS (provide as required including but not limited to)

A. Chain-Link Fencing

B. Portable Chain-Link Fencing

C. Polyethylene Sheet

D. Dust Control Adhesive-Surface Walk-off Mats:

E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Must be inside project area, no additional space provided by Owner.

B. Storage and Fabrication Sheds: Must be inside project area, no additional space provided by Owner

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, obtain further, detailed direction from engineer and owner.

C. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to system as directed by Owner.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

F. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.

a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

H. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

I. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

J. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service as required, unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

K. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

L. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel as required.

1. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Architect's office.
e. Engineers' offices.
f. Owner's office.
g. Principal subcontractors' field and home offices.

2. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

M. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access project electronic documents and maintain electronic communications. Equip computer with not less than the following:

1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these 3 functions.
2. Internet Service
3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing and spam protection in a combined application.
4. Backup: External hard drive, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Parking: Obtain direction from Owner on use of parking areas (if any) for construction personnel.

C. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

E. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

H. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

J. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 Section "Site Clearing."

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from the project site during the course of the project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Comply with requirements specified in Division 01 Section "Temporary Tree and Plant Protection."

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

H. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

K. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

1. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction

2. Construct covered walkways using scaffold or shoring framing.
3. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
4. Paint and maintain appearance of walkway for duration of the Work.

L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to occupied areas from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.

a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.

2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Insulate partitions to control noise transmission to occupied areas.
4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
5. Protect air-handling equipment.
6. Provide walk-off mats at each entrance through temporary partition.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 24 hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.

c. Remove materials that can not be completely restored to their manufactured moisture level within 24 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - MATERIALS AND EQUIPMENT

PART 1 PRODUCTS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

B. The Contractor's Construction Schedule and the Schedule of Submittals are included under Section "Submittals."

C. Standards: Refer to Section "Definitions and Standards" for applicability of industry standards to products specified.

D. Administrative procedures for handling requests for substitutions made after award of the Contract are included under Section "Product Substitutions."

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms such are self-explanatory and have well recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

    a. "Named Products" are items identified by manufacturer's product name, including make or model designation, indicated in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
    b. "Foreign Products", as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions; or produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of nor living within the United States and its possessions.

2. "Materials" are products that are substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

1.4 SUBMITTALS

A. Product List Schedule: A list of products required is included at the end of this Section. Prepare a schedule in tabular form showing each product listed. Include the manufacturer's name and proprietary product names for each item listed.

B. Product List Schedule: Prepare a schedule showing products specified in a tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate the product list schedule with the Contractor's Construction Schedule and the Schedule of Submittals.
2. Form: Prepare the product listing schedule with information on each item tabulated under the following column headings:

    a. Related Specification Section number.
    b. Generic name used in Contract Documents.
    c. Proprietary name, model number and similar designations.
    d. Manufacturer's and name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date, or time span of delivery period.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of an initial product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.

    a. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.

4. Completed Schedule: Within 60 days after date of commencement of the Work, submit 3 copies of the completed product list schedule. Provide a written explanation for omissions of data, and for known variations from Contract requirements.
5. Architect's Action: The Architect will respond in writing to the Contractor within 2 weeks of receipt of the completed product list schedule. No response within this time period constitutes no objection to listed manufacturers or products, but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include the following:

    a. A list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.

1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect for a determination of the most important product qualities before proceeding. Qualities may include attributes relating to visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources that produce products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: When the Contractor is given the option of selecting between two or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each prime Contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate Contractors.
2. If a dispute arises between prime Contractors over concurrently selectable, but incompatible products, the Architect will determine which products shall be retained and which are incompatible and must be replaced.

C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:

1. No available domestic product complies with the Contract Documents.
2. Domestic products that comply with Contract Document are only available at prices or terms that are substantially higher than foreign products that also comply with the Contract Documents.

D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface which is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products in accordance with the manufacturer's recommendations, using means and methods that will prevent damage, deterioration and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
3. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

1.7 PRODUCT WARRANTIES

A. Provide maximum warranty for product, submit documentation.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, unused at the time of installation.

1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: Product selection is governed by the Contract Documents and governing regulations, not by previous Project experience. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.
2. Semiproprietary Specification Requirements: Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.

    a. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal" comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

3. Non-Proprietary Specifications: When the Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements, and are recommended by the manufacturer for the application indicated. General overall performance of a product is implied where the product is specified for a specific application.

    a. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.

6. Compliance with Standards, Codes and Regulations: Where the Specifications only require compliance with an imposed code, standard or regulation, select a product that complies with the standards, codes or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.

    a. Where no product available within the specified category matches satisfactorily and also complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category, or for noncompliance with specified requirements.

8. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard colors, patterns, textures..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern and texture from the product line selected.
9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division-1 for allowances that control product selection, and for procedures required for processing such selections.

PART 3 EXECUTIION

3.1 INSTALLATION OF PRODUCTS:

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

    1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 016000

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least (10) calendar days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Owner Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety. Operating elements include the following:

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.
9. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or

adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect[will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION – LIST OF CLOSE OUT ITEMS

a. Maintenance and/or Service Contract(s)
b. Substantial Completion Form
c. Certificate of Final Completion
d. Application for Final Payment
e. Final Release of Lien
f. Consent of Surety (if relevant)
g. Certificate of Occupancy
h. Roof Warranty from Manufacture (two copies)
i. Maintenance and Operation Manuals (HVAC, equipment etc.) and Catalog Data
j. All DOB Close Out Documents
k. CD-Rom with All Contract Documents, Record Drawings, Specifications, etc.
l. Contractors One Year Workmanship, Materials Warranty
m. Certificate of Air Balance
n. Miscellaneous Equipment and System Warranty(s)
o. Contractor Supplied Training on Equipment and Systems (with sign-in sheets)
p. Videos/CD's and Training Manuals on Controls, HVAC, and Equipment
q. Equipment and System Inspections Reports:
r. Contractor Provided Written Instructions on Seasonal Adjustments
s. All Overages
t. Progress Photos

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment**[, elevator equipment,]** and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.

1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.

r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. Construction Waste Disposal: Comply with waste disposal requirements.

END OF SECTION 17700

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building
2. Salvage of existing items to be reused or recycled.
3. Salvage of all removed brick to be stored carefully and saved for reuse on the façade.

B. GC to do everything possible to re-use as many bricks as possible that are removed from the existing facade in the new work on the façade. Each brick shown to be removed must be removed individually and carefully, and then stored individually and carefully, so they can be re-used in the new work.

C. GC to coordinate removal of brick, windows, and roofing so as to prevent water infiltration into the building from the beginning to the end of the project. Provide protection at all times immediately upon removals until these areas are replaced with new material.

DEFINITIONS

B. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

C. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

D. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

E. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 SUBMITTALS

A. Qualification Data: For demolition firm, and professional engineer.

B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust- and noise-control temporary partitions and means of egress, including for other tenants affected by selective demolition operations.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.

E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.4 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.5 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

1. Comply with requirements specified in Division 01 Section "Summary."

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes and templates.

1. Comply with requirements specified in Division 01 Section "Photographic Documentation."

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.

1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

E. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 07 Section "SBS Modified Bitumen Membrane Roofing" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

F. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Refer to drawings for specific scope and listing of items to be removed, removed and salvaged, removed and reinstalled, and existing to remain.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. In the event of conflict between any of the provisions of these documents, including the Drawings and this section of the specification, the requirements of the more stringent shall govern.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Description of Work.

1. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
2. Extent of concrete work is all cast-in-place concrete, including but not limited to footings, concrete toppings on metal deck, and all other concrete as shown on the Drawings.
3. All concrete specified in this Section is to be reinforced with steel bars. In the event no reinforcing is indicated in a particular concrete element the Contractor shall provide sufficient allowance in his price for 200 lbs. (125.6 kg/m3) of reinforcing per cubic yard of concrete.

B. Responsibilities of Contractor

1. The Contractor shall be responsible for the construction of all Cast-In-Place Cement Concrete work as defined by the Contract Documents.
2. The Contractor shall be responsible for all providing whatever form-work is necessary to achieve the final shapes of the Concrete components as defined by the Contract Documents.
3. The Contractor is responsible for installing all assemblies to be embedded in the final concrete components as provided by this Contractor or others and as described or implied by the Contract Documents.
4. The Contractor shall be responsible to coordinate the work with the work of all other trades including locating, detailing and providing penetrations for other work.

C. Related Sections include the following:
1. Masonry work is specified in Division 4.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. General:

1. Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
2. The Architect shall review the Contractor's submittals for general compliance with the Contract Documents for strength and serviceability only, this review shall not be for accuracy of dimensions, fit-up, constructability, or for coordination of shop drawings.

B. Product Data: Submit data for proprietary materials and items, including reinforcement and forming accessories, bearing assemblies, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, aluminum oxide, and others as requested by Architect. Include manufacturer's certifications and laboratory test reports as required.

C. Shop Drawings: The Contractor shall submit shop drawings to the Architect for review in accordance with the General Conditions of the Contract. The Contractor shall budget sufficient time in his schedule to allow for the Architect's review of shop drawings. The Architect's review shall be conducted as timely as is possible under the circumstances, but the Contractor shall allow on average for shop drawing submittals to remain in the Architect's possession an average of 10 **working days for shop drawing review.** The Contractor shall allow for longer review periods for submittals of above average complexity, when extensive design calculations are part of the submittal or when many drawings are submitted together.

The Contractor should allow in his schedule for the likelihood that some shop drawing submittals will have to be submitted more than once for review of the Architect.

1. Shop drawings shall be carefully checked before being submitted to the Architect for review, and shall be submitted in the order in which they are needed for the execution of the work, not all at once, to a schedule previously agreed with the Architect, but at least four, 4, weeks prior to fabrication.
2. Submit the required number of copies of all shop drawings to the Architect. The Architect will return, marked with his comments, one sepia of each shop drawing to the Contractor. Submit sufficient copies of final versions of drawings and other submittals for distribution to all parties.
3. The Contractor shall immediately make all corrections to his drawings as noted by the Architect in his review, or as required by changes ordered or authorized by the Owner. The Contractor shall keep a satisfactory history of all changes by noting all revisions with separately numbered and dated revision notes on a convenient portion of each drawing affected. The pertinent revision number and date shall be prominently displayed on each drawing. Changes to revised drawing submittals shall be highlighted so that the changed portion of the drawing is distinguished from the balance of the information.
4. Shop drawings shall clearly identify all material types, grades, etc.
5. Up date all shop, field work, and placement drawings as required through the fabrication and construction of the work. Upon completion of concrete construction, submit at least four sets of "as-built" drawings to the Architect for record purposes.
6. The Contractor shall not fabricate any material until after the Architect's review of field work drawings nor proceed with any work for which such drawings are required until they have been reviewed by the Architect. Field work drawings shall be submitted for review first. Reinforcing l shop drawings shall not be submitted until the field work drawings have been reviewed and returned by the.
7. Field work drawings shall be drawn to a scale no smaller than 1/10"=1'-0" (1cm=1m) with section and detail sketches to a larger scale. Field work drawings shall clearly identify all

designations to be utilized to identify the separate components of the structure. Field work drawings shall include details of sequence of construction, shores, towers, and other pertinent information.

8. Reference all layout and installation drawings of all anchor bolts and other items by others to be embedded in concrete work. Drawings shall dimension the locations of all embedded items noting pertinent tolerances for the installation. Such drawings shall be submitted no later than four, 4, weeks following the contract start date.
9. Update all shop drawings as required through the fabrication and erection of the work. Upon completion of erection, submit "as-built" drawings to the Architect for record purposes.

D. Provide Field Work Drawings which provide the following information:

1. Provide elevations, plans, and/or isometric shop drawings defining the final shape of all concrete components.
2. Define the edge treatment for all concrete edges which are not fully encased by the concrete form-work and any edges where specialty form materials are added to the typical form materials.
3. Define the placement of all form ties for “exposed-to-view” concrete surfaces.
4. Indicate layout, dimensions, and identification of all construction joints, control joints, and expansion joints based upon the concrete placement sequence and procedure of installation. Indicate all reinforcing splices. Detail inserts, connections, and joints, including accessories and reinforcing at openings in walls and floors.
5. Coordinate control joints, construction joints and form joints in exposed vertical surfaces with the Architect's reveal pattern. Submit drawings showing form joints and construction joints, and obtain Architect's approval before proceeding.
6. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect. If construction joints are introduced other than where shown on the Drawings, the Contractor shall demonstrate that the strength of the components or members with the construction joints are not adversely effected.
7. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints.
8. Control Joints: Locate and detail control joints in slabs and walls at spacing not to exceed maximums specified.
9. Provide dimensional location and details of anchorage devices that are to be embedded by others in other construction. Furnish templates if required for accurate placement.
10. Cross reference applicable steel reinforcing shop drawings on Field Work Drawings.

E. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Show organization of stirrups and longitudinal reinforcing bars through all intersection of components.

F. Shop Drawings; Formwork: Submit shop drawings prepared by a professional engineer registered in the State of South Carolina for fabrication and erection of forms for specific finished concrete surfaces, as indicated. Show general construction of forms including jointing, special form joint or reveals, location and pattern of form tie placement, and other items which affect exposed concrete visually.

1. Architect's review of formwork shop drawings is for general architectural applications and features only. Design of formwork for structural stability, strength, safety and efficiency is Contractor's sole responsibility.
2. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

G. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mix water to be withheld for later addition at Project site.

H. Welding Certificates: Copies of certificates for welding procedures and personnel.

I. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

J. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials and aggregates.
2. Form materials and form-release agents.
3. Steel reinforcement and reinforcement accessories.
4. Fiber reinforcement.
5. Admixtures.
6. Waterstops.
7. Curing materials.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Epoxy joint filler.
13. Joint-filler strips.
14. Repair materials.

K. Provide Batch Tickets per the requirements of ASTM C 94 with additional information as specified herein, see paragraph 2.06, B.

L. PRE-CONCRETE PLACEMENT MEETING:

Prior to commencement of concrete work but after design and submittal of concrete mixes, arrange a meeting with the Contractor, the Architect, and the Testing Agency to review the Contractor's intended placement procedures, the mix designs, hot and/or cold weather procedures, any critical areas, and the schedule for concrete work..

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified. Latest editions of each standard will apply, unless specifically identified otherwise:

1. New York State Building Code
2. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials".
3. ACI 301 "Specifications for Structural Concrete for Buildings".
4. ACI 302 " Guide for Concrete Floor and Slab Construction".
5. ACI 304 "Recommended Practice for Measuring Mixing, Transporting, and Placing Concrete"
6. ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures"
7. ACI 318 "Building Code requirements for Reinforced Concrete".
8. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
9. American Society for Testing and Materials (ASTM) - as referenced herein.
10. American Welding Society - "Structural Welding Code , Reinforcing Steel, ANSI/AWS D1.4"

C. Professional Engineer Qualifications: A professional engineer who is legally and , licensed in the state of New York, where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.

D. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

E. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

F. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

G. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1. Before submitting design mixes, review concrete mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixes.
c. Ready-mix concrete producer.

d. Concrete subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Avoid damaging coatings on steel reinforcement.
2. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963/D 3963M.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints. . Conform to joint system where shown on drawings.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1, or better.
b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
c. Structural 1, B-B, or better, mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Use only for concrete surfaces not exposed to view. Plywood, lumber, metal, or another approved material may be used. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Plain-Steel Wire: ASTM A 82, as drawn.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. For slabs-on-grade including structural slabs-on-grade use supports with sand plates or horizontal runners where base materials will not support chair legs. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
1. Maximum aggregate sizes:

a. Footings -Nominal Maximum Aggregate Size:<3/4

2. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).

C. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

2.6 VAPOR RETARDERS

A. Vapor Retarder: ASTM E 1745, Class C, of one of the following materials; or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick:

1. Nonwoven, polyester-reinforced, polyethylene coated sheet; 10 mils (0.25 mm) thick.
2. Three-ply, nylon- or polyester-cord-reinforced, laminated, high-density polyethylene sheet; 7.8 mils (0.18 mm) thick.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 22 percent solids.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

J. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

K. Products: Subject to compliance with requirements, provide one of the following:

1. Evaporation Retarder:

    a. Cimfilm; Axim Concrete Technologies.
    b. Finishing Aid Concentrate; Burke Group, LLC (The).
    c. Spray-Film; ChemMasters.
    d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
    e. Sure Film; Dayton Superior Corporation.
    f. Eucobar; Euclid Chemical Co.
    g. Vapor Aid; Kaufman Products, Inc.
    h. Lambco Skin; Lambert Corporation.
    i. E-Con; L&M Construction Chemicals, Inc.
    j. Confilm; Master Builders, Inc.
    k. Waterhold; Metalcrete Industries.
    l. Rich Film; Richmond Screw Anchor Co.
    m. SikaFilm; Sika Corporation.
    n. Finishing Aid; Symons Corporation.
    o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.

2. Clear, Solvent-Borne, Membrane-Forming Curing Compound:

    a. AH Clear Cure; Anti-Hydro International, Inc.
    b. Spartan-Cote; Burke Group, LLC (The).
    c. Spray-Cure & Seal 15; ChemMasters.
    d. Conspec #1-15 percent solids; Conspec Marketing & Manufacturing Co., Inc.
    e. Day-Chem Cure and Seal; Dayton Superior Corporation.
    f. Diamond Clear; Euclid Chemical Co.

g. Nitocure S; Fosroc.
h. Cure & Seal 309; Kaufman Products Inc.
i. Lambco 120; Lambert Corporation.
j. L&M Dress & Seal 18; L&M Construction Chemicals, Inc.
k. CS-309; W. R. Meadows, Inc.
l. Seal N Kure; Metalcrete Industries.
m. Rich Seal 14 percent UV; Richmond Screw Anchor Co.
n. Kure-N-Seal; Sonneborn, Div. of ChemRex, Inc.
o. Flortec 14; Sternson Group.
p. Cure & Seal 14 percent; Symons Corporation.
q. Clear Seal 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
r. Acrylic Cure; Unitex.
s. Certi-Vex AC 309; Vexcon Chemicals, Inc.

3. Clear, Waterborne, Membrane-Forming Curing Compound:

a. AH Clear Cure WB; Anti-Hydro International, Inc.
b. Klear Kote WB II Regular; Burke Chemicals.
c. Safe-Cure & Seal 20; ChemMasters.
d. High Seal; Conspec Marketing & Manufacturing Co., Inc.
e. Safe Cure and Seal; Dayton Superior Corporation.
f. Aqua Cure VOX; Euclid Chemical Co.
g. Cure & Seal 309 Emulsion; Kaufman Products Inc.
h. Glazecote Sealer-20; Lambert Corporation.
i. Dress & Seal WB; L&M Construction Chemicals, Inc.
j. Vocomp-20; W. R. Meadows, Inc.
k. Metcure; Metalcrete Industries.
l. Cure & Seal 150E; Nox-Crete Products Group, Kinsman Corporation.
m. Rich Seal 14 percent E; Richmond Screw Anchor Co.
n. Kure-N-Seal WB; Sonneborn, Div. of ChemRex, Inc.
o. Florseal W.B.; Sternson Group.
p. Cure & Seal 14 percent E; Symons Corporation.
q. Seal Cure WB 150; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
r. Hydro Seal; Unitex.
s. Starseal 309; Vexcon Chemicals, Inc.

4. Clear, Waterborne, Membrane-Forming Curing Compound, 18 to 22 Percent Solids:

a. Klear Kote WB II 20 percent; Burke Chemicals.
b. Safe-Cure & Seal 20; ChemMasters.
c. Conspec 21; Conspec Marketing & Manufacturing Co., Inc.
d. Diamond Clear VOX; Euclid Chemical Co.
e. SureCure Emulsion; Kaufman Products Inc.
f. Glazecote Sealer-20; Lambert Corporation.
g. Dress & Seal WB; L&M Construction Chemicals, Inc.
h. Vocomp-20; W. R. Meadows, Inc.
i. Metcure 0800; Metalcrete Industries.
j. Cure & Seal 200E; Nox-Crete Products Group, Kinsman Corporation.
k. Rich Seal 18 percent E; Richmond Screw Anchor Co.
l. Kure-N-Seal W; Sonneborn, Div. of ChemRex, Inc.
m. Florseal W.B.; Sternson Group.
n. Cure & Seal 18 percent E; Symons Corporation.

o. Seal Cure WB STD; Tamms Industries Co., Div. of LaPorte Construction Chemicals of North America, Inc.
p. Hydro Seal 800; Unitex.
q. Starseal 0800; Vexcon Chemicals, Inc.

5. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound:

a. Spray-Cure & Seal Plus; ChemMasters.
b. UV Super Seal; Lambert Corporation.
c. Lumiseal Plus; L&M Construction Chemicals, Inc.
d. CS-309/30; W. R. Meadows, Inc.
e. Seal N Kure 30; Metalcrete Industries.
f. Rich Seal 31 percent UV; Richmond Screw Anchor Co.
g. Cure & Seal 31 percent UV; Symons Corporation.
h. Certi-Vex AC 1315; Vexcon Chemicals, Inc.

6. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:

a. Klear-Kote Cure-Sealer-Hardener, 30 percent solids; Burke Group, LLC (The).
b. Polyseal WB; ChemMasters.
c. UV Safe Seal; Lambert Corporation.
d. Lumiseal WB Plus; L&M Construction Chemicals, Inc.
e. Vocomp-30; W. R. Meadows, Inc.
f. Metcure 30; Metalcrete Industries.
g. Vexcon Starseal 1315; Vexcon Chemicals, Inc.

2.8 RELATED MATERIALS

A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

C. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

D. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.

E. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

F. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

G. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

H. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Footings and Foundation Walls: Proportion normal-weight concrete mix as follows:
1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Maximum Slump: 4 inches (100 mm).

D. Cementitious Materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.

E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent portland cement minimum, with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

F. Maximum Water-Cementitious Materials Ratio: 0.50

G. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2 to 4 percent, unless otherwise indicated.

H. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
1. Air Content: 6 percent for 3/4-inch- (19-mm-) nominal maximum aggregate size.

I. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.

J. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

K. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixes where indicated.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch tickets with each batch delivery to the site before unloading. All batch tickets shall provide the following information in addition to that mandated by ASTM C 94:

1. Type, brand and amount of cement.
2. Type, brand and amount of admixtures.
3. Maximum aggregate size.

B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. During Hot Weather, when air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
2. During Cold-Weather, comply with requirements of Section 3.9.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.13 Non-Shrink Grout: CRD-C621, Factory Premixed grout.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3 mm).
2. Class B, 1/4 inch (6 mm).
3. Class C, 1/2 inch (13 mm).
4. Class D, 1 inch (25 mm).

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Do not chamfer corners or edges of concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.
2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. 28-day design compressive strength.
2. At least 70 percent of 28-day design compressive strength.
3. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
4. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M), ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Vapor Retarder: Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.

B. Fine-Graded Granular Material: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

C. Granular Fill: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

1. Place and compact a 1/2-inch- (13-mm-) thick layer of fine-graded granular material over granular fill.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing plus 2 inches (50mm). Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Architect.

C. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

D. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

E. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.

C. Rubbed Finish: Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with recommendations in ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Provide slopes to drains and depressions in slab surfaces as required per the Architectural Drawings.

C. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.

1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.

D. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

E. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
2. Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/E 1155M for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and levelness, F(L) 15.
    b. Specified overall values of flatness, F(F) 35; and levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and levelness, F(L) 17; for slabs-on-grade.
    c. Specified overall values of flatness, F(F) 30; and levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and levelness, F(L) 15; for suspended slabs.
    d. Specified overall values of flatness, F(F) 45; and levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and levelness, F(L) 24.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled freestanding 10-foot- (3.05-m-) long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:

    a. 1/4 inch (6.4 mm).
    b. 3/16 inch (4.8 mm).
    c. 1/8 inch (3.2 mm).

F. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. Immediately after second troweling, and when concrete is still plastic, slightly scarify surface with a fine broom.

G. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

H. Slip-Resistive Aggregate Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.

I. Mineral Dry-Shake Floor Hardener Finish: After initial floating, apply mineral dry-shake materials to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply mineral dry-shake materials at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m), unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of mineral dry-shake materials over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second mineral dry-shake application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake material manufacturer and apply immediately after final finishing.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

E. Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout.

F. Protect reinforcing which will extend from concrete for protracted periods of time, to prevent rust stains from staining concrete.

G. Protect all exposed concrete from damage from subsequent construction operations.

3.11 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written

instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and non-shrink patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Article.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

C. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mix placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
7. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

   a. Cast and field cure one set of four standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.

   a. Test two field-cured specimens at 7 days and two at 28 days.
   b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.

D. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

E. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

F. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

G. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

H. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.

END OF SECTION 033000

SECTION 040110 – BRICK MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cleaning brick masonry surfaces within the Project scope area.

B. Related Specification Sections

1. Section 040120 – “Brick Masonry Repair”

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (690 to 2750 kPa); 4 to 6 gpm (0.25 to 0.4 L/s)
B. Medium-Pressure Spray: 400 to 800 psi (2750 to 5510 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).
C. High-Pressure Spray: 800 to 1200 psi (5510 to 8250 kPa); 4 to 6 gpm (0.25 to 0.4 L/s).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:

a. Verify masonry-cleaning equipment and facilities needed to make progress and avoid delays.
b. Materials, material application, and sequencing.
c. Cleaning program.
d. Coordination with brick repair sequence as well as building occupants.

1.4 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform masonry-cleaning work in the following sequence:

1. Complete physical inspection of the brickwork. Inspect for open mortar joints and large cracks.
2. Delay further cleaning work until after repairs are completed to prevent the intrusion of water and other cleaning materials into the wall.
3. Clean masonry surfaces.

1.5 SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions and application instructions.
2. Include test data substantiating that products comply with requirements.

B. Qualification Data: For chemical-cleaner manufacturer and applicator..

C. Preconstruction Test Reports: For cleaning materials and methods.

D. Cleaning program.

1.6 QUALITY ASSURANCE

A. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site preconstruction product testing and on-site assistance.

B. Masonry Cleaning Personnel:: Use only experienced personnel to perform work of this Section. Applicators shall have completed work similar in material, design, and extent to that indicated for this Project, and shall have a minimum of three (3) years experience working on similar project.

C. Field Samples: In the presence of the Engineer of Record and the manufacturer’s technical representative, prepare initial samples of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution. Refer to drawings for mockup locations.

1. Cleaning: Clean an area approximately 50 sf for each type of masonry and surface condition. If initially specified cleaner proves unsatisfactory, repeat field sample with a more aggressive cleaner until satisfactory cleaning is achieved.
   a. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

2. Approved field sample can be used as basis of selection of replacement brick. Approval sample shall serve as a standard against which all subsequent cleaning shall be judged.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning work to be performed according to product manufacturers' written instructions and specified requirements.

B. Clean masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to remain so for at least seven days after completion of cleaning.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Restoration Cleaner: for removing atmospheric staining and general cleaning brick “Sure Klean Restoration Cleaner”, by Prosoco, Lawrence, KS. Subject to compliance with project requirements, acceptable alternative manufacturers include:

1. Diedrich Technologies
2. Dumond Chemicals, Inc.
3. Cathedral Stone Products

B. Field sample cleaning may demonstrate that a stronger masonry cleaner is required. In this case, use “Sure Klean Heavy Duty Restoration Cleaner” to clean brick.

C. Water: Potable.

2.2 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

PART 3 - EXECUTION

3.1 PROTECTION

A. Comply with manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
3. Neutralize alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.2 CLEANING MASONRY, GENERAL

A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet (6 m) away by Engineer of Record.

B. Before applying cleaners, review Preparation and Safety Information sections on manufacturer's Product Data Sheets. Apply cleaners to masonry surfaces according to manufacturer's written instructions

C. Proceed with cleaning in an orderly manner; work from bottom to top of each scaffold width and from one end of each elevation to the other. Always pre-wet surface with water. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

D. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.

E. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

F. Water Application Methods:

1. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or low-pressure spray application. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

I. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

J. Chemical Cleaning:

1. Working from the bottom to the top, pre-wet surface with fresh water.
2. Apply diluted cleaning solution directly to surface with recommended masonry brush or low-pressure spray.
3. Let diluted cleaning solution stay on the surface for 3 to 5 minutes or until stains are gone, but in no case long enough to “burn” the face of masonry. Follow manufacturer’s instructions and dwell times determined during field sample execution. If treated surfaces are left unattended, keep people away from the cleaner.
4. Working from the bottom to the top, reapply cleaner and rinse thoroughly with fresh water to get all residues off the surface. If pressure-rinsing equipment is not available, brush the surface while rinsing with clean water.
5. When cleaning vertical surfaces, keep lower areas wet to avoid streaks.
6. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage chemical-cleaner manufacturer's factory-authorized service representatives for consultation, to perform preconstruction product testing, and provide on-site assistance when requested by Engineer of Record.

3.4 FINAL CLEANING - See Specification 040120 – “Brick Masonry Repair”

END OF SECTION 040110

SECTION 040120 - BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Close-up, “hands on” inspection, including visual inspection and sounding of existing brick facades between the second and third floors and between and along the three sides of the building bordering the third floor roof, and evaluation of existing steel lintels included in the scope of this Project.
2. Identification and procurement of replacement brick to match existing brick veneer.
3. Selection of setting and pointing mortars of appropriate strength, composition and color.
4. Raking out of all mortar joints in selective areas within the Project scope.
5. Installation of stainless steel joint reinforcement where indicated to create spanning capability of existing brick over areas where brick shall be removed and replaced.
6. Installation of stainless steel tie-back anchors at locations where lateral bracing of existing brick veneer where indicated and where necessary.
7. Selective removal of existing brick where indicated and as required.
8. Repair and/or replacement of steel lintels over window openings.
9. Installation of stainless steel sheet metal flashings over lintels.
10. Installation of butyl-based self-adhering sheet membrane flashing and edge sealant lapped over sheet metal flashings and bonded over existing flashing membranes behind brick veneer.
11. Installation of replacement brick veneer as indicated and required. Rake out head and bed joints to match adjacent masonry.
12. Repoint all raked out joints across the area within Project scope.
13. Form control joints within the masonry veneer where indicated and as required.
14. Final washdown and cleaning of repointed masonry veneer.
15. Field samples for approval of every step of the repair and cleaning processes.
16. Temporary protection of brick veneer throughout the work process.
17. Mortar testing.

1.2 ALTERNATES

A. Add Alternate No. 1: Conduct an initial, thorough cleaning of all designated masonry surfaces within the Project area prior to the raking out of mortar joints and/or the removal of existing brick masonry. See Specification Section 040110 “Brick Masonry Cleaning” for information regarding materials and methods of execution.

1.3 UNIT PRICES

A. Unit Price No. 1: Provide price per square foot of exposed veneer brick to include the removal of existing brick and replacement with new brick, including raking out of new mortar joints and repointing of same.

1.4 DEFINITIONS

A. Repointing: The process of removing (raking out) mortar and replacing it with new mortar.

B. Pointing: The process of placing new mortar in existing joint spaces, which have previously been raked out. This term does not include the raking out process.

C. Raking Out: removal of existing mortar from joints in preparation for pointing operations.

D. Setting Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

E. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

F. Field Samples: small examples of specific installations and/or techniques that are executed at the beginning of each type of work and which will be reviewed and approved by the Engineer of Record. Field samples that are not approved shall be modified or redone as required by the Engineer of Record. Field samples that are approved shall be incorporated into the final work and will serve as a standard against which subsequent work of a similar nature will be judged..

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to brick masonry repair including, but not limited to, the following:

a. Materials, material application, sequencing, tolerances, and required clearances.
b. Quality-control program, including temporary protection and mortar testing.
c. Coordination with building occupants.
d. Coordination with other trades working in the same Project areas.

1.6 SEQUENCING AND SCHEDULING

A. Order replacement materials at the earliest possible date, to avoid delaying completion of the Work. To this end, perform the following activities at the earliest possible time:

1. Create a sample of no less than five cleaned existing bricks taken from the building fabric to compare against no less than four possible replacement brick samples. Obtain approval from the Engineer of Record of one or more brick types to be used as replacement bricks.

B. Identify a representative area of existing mortar no less than 10 sf and clean thoroughly. Using this sample as a basis, select three manufacturer’s architectural samples of closely matching mortar for review and selection by the Engineer of Record.

C. Perform brick masonry restoration work in the following sequence:

1. Inspect brick walls throughout the Project area. Sound brickwork and mark areas where brick appears to be loose, bulging, or otherwise unsound. Mark all locations where

mortar is loose, cracked or badly weathered. Inspect steel lintels for evidence of rust-jacking, bending or bowing. Determine the extent to which brick and lintel replacement and repair is needed. Review with Engineer of Record to verify the scope of work.

2. Complete removals of existing copings/parapets where indicated.
3. Establish and maintain adequate temporary protection of all areas under construction throughout course of work.
4. Rake out existing head and bed joints in areas where indicated and as determined through inspection.
5. Install reinforcement hardware into raked joints where indicated and as determined through inspection.
6. Remove existing brick veneer where indicated and as determined through inspection.
7. Remove and repair or replace existing steel lintels where indicated and where identified during inspection.
8. Install new sheet metal and modified bitumen flashings, including end dams and edge seals.
9. Install new replacement masonry where indicated and as necessary.
10. Form control joints in masonry where shown and as necessary as directed by the Engineer of Record.
11. Repoint all mortar joints of both existing and new masonry where raking out has occurred.
12. Wash down masonry surfaces.

D. As scaffolding is removed, patch anchor holes used to attach scaffolding.

1.7 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Submit building elevations showing locations of all brick and lintel/flashing replacement as well as repointing work. Provide linear dimensions, areas and other information required to determine unit price costs.
2. Submit one or more scaled sectional details through typical areas of brick, lintel and flashing replacement. Show treatment of for flashing and weep holes as required.
3. Where required, show provisions for control joints or other sealant joints.
4. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.

   a. Submit with precise measurements on ingredients, proportions, gradations, and sources of sands from which each sample was made.

2. Sand Types Used for Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars. Identify sources (both supplier and quarry) of each type of sand.
3. Three cubes 2" square of each mortar mix selected, suitable for testing purposes.
4. Each type of lateral anchor.
5. Each type of reinforcing channel and fixing pin.
6. Chemicals used in final washdown..

D. Samples for Verification: For the following:

1. Each type of brick unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.
2. Accessories: Each type of accessory and miscellaneous support.

E. Qualification Data: For mortar testing service.

F. Preconstruction Test Reports:

1. Mortar Testing: submit laboratory results and report of findings of required testing of replacement mortars and masonry units.

G. Field Quality Control Program: see requirements below.

1.8 VENEER BRICK SELECTION PROCESS

A. Conduct a process of brick identification and final selection which will determine the best available match for existing brick veneer. Coordinate this process with additional submittal requirements listed under “SUBMITTALS” above.

B. Obtain no less than five samples of each type of brick from an approved location on the façade and clean them using approved materials and techniques.

1. Alternatively, bring sample boards of potential bricks to the job site and compare to in-place brick which has been cleaned

C. Initial Selections: Working with any or all of the below-listed brick suppliers, identify as many as four different brick types which appear to be potential matches for the existing bricks in size, color(s), texture(s) and durability.

1. Suppliers:

a. Belden Brick Sales & Service, Inc.
b. Glen Gery Brick
c. Tri-State Brick & Building Materials, Inc.

2. Provide straps or panels containing sufficient numbers of bricks to verify a successful match with existing brick units, but in no case less than 8 brick units. Alternately, prepare “dry” sample boards of each type of brick to be evaluated approximately six courses high and two stretchers wide (2sf). Include full range of potential variations within the sample boards.
3. Meet on site with the Engineer of Record and evaluate each selection. Assume no less than two of the original eight selections will be selected for further evaluation.

D. Second Round Selection:

1. Based on the results of the initial selection process, construct two 4’ x 4’ vertical mockups on site using the selected brick(s). Note: if mortar is used to construct this mockup, use gray Portland cement and white sand; keep all mortar away from face of brick; rake all joints minimum 1” back from brick arrises.
2. Review samples with the Engineer of Record (and others at his invitation), who may offer suggestions for modification requiring reconstruction of one or both mockups.
3. Make modifications in the placement and frequency of each type of brick as requested until acceptable brick mockups are produced. Record composition of approved mockups, designating each brick type and percentage.
4. Preserve and protect approved mockups on site.

E. Pointing Mortar Selection:

1. Based on initial sample selections of pointing mortar (see “SUBMITTALS” below), apply mortar samples to the mockup, using placement, tooling and texturing techniques as requested by the Engineer of Record.
2. Allow to cure for a minimum of seven days prior to review. If required, rake out initial mortar selections and replace with others until an acceptable pointing mortar is selected. Record approved mortar by name and composition, listing all components and percentages. If blended sand is used, also list percentage of each type of sand in the blend.
3. Preserve and protect approved mockups on site.

1.9 QUALITY ASSURANCE

A. Source of Materials: Obtain materials for masonry restoration from a single source for each type of material required (face brick, cement, sand, etc.) to ensure a match of quality, color, pattern, and texture.

B. Field Quality Control: Prepare written program describing all means by which repointing and repair will be maintained meeting the specified requirements. Include supervisory provisions, maintenance of temporary protection, maintenance of proper mortar mix design, batching sizes, raking out procedures (if power tools are used, include precautions to prevent damage and worker fatigue), pointing procedures, and final cleandown procedures.

C. Field Samples: Prepare field samples for each type of operation to be encountered. Where requested, conduct specific field samples only in the presence of the Engineer of Record. Use materials and methods proposed for completed Work and prepare samples under same weather conditions to be expected during remainder of Work. Field samples, when approved, will serve as the standard of quality required of all subsequent work of similar nature. Locate field samples on the building where directed by the Engineer of Record. Obtain Engineer’s approval of each field sample before starting the remainder of masonry repair.

1. Raking Out: Rake out existing masonry joints across an area no less than 48” x 60” using techniques to be used during the rest of the Project.
2. Masonry Removal: Remove all masonry required over one representative window unit., using Project-specific techniques, taking care to minimize damage to adjacent bricks scheduled to remain in place. “Tooth” existing masonry to remain, removing all existing mortar from the toothed edges.
3. Lintel Replacement and Flashing: Replace one lintel and reflash as required. Use only approved materials and techniques.

4. Brick Replacement: install replacement bricks in one prepared opening, maintaining acceptable joint alignments and tolerances.
5. Repointing: Prepare a small batch of approved mortar and apply to a sample area approximately 24 inches high and 60-inches long and allow to cure. Then prepare a second small batch of mortar for the same mortar and apply to a second 24-inch high, 60-inch wide area immediately adjacent to the first to demonstrate uniformity of batching, water content, finishing and color.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Carefully pack, handle, and ship masonry units and accessories strapped together in suitable packs or pallets or in heavy-duty cartons.

B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with type and name of products and manufacturers.

C. Store cementitious materials off the ground, under cover, and in a dry location.

D. Store aggregates, covered and in a dry location, where grading and other required characteristics can be maintained and contamination avoided.

E. Comply with manufacturer's written instructions for minimum and maximum temperature requirements for storage.

1.11 PROJECT CONDITIONS

A. Do not repoint mortar joints or set masonry unless air temperature is between 40 and 80 deg F (4 and 27 deg C) and will remain so for at least 48 hours after completion of Work.

B. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing:

1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
2. When mean daily air temperature is between 25 and 40 deg F (minus 4 and 4 deg C), cover completed Work with weather-resistant, insulating blankets for 48 hours after repair and pointing.
3. When mean daily air temperature is below 25 deg F (minus 4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after setting and/or pointing.

C. Hot-Weather Requirements: Protect restoration work when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above.

D. Provide final washdown of completed masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and will remain so for at least 7 days after completion of cleaning.

E. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Immediately remove grout and mortar in contact with exposed masonry and other surfaces.

F. Use grinding and other power tools equipped with dust control devices, and take other steps to minimize the amount of dust generated during the raking out operations. Clean surfaces of cars exposed to mortar dust each day.

G. Protect sills, ledges, and projections from mortar droppings.

H. If local ordinances require it, recover and/or recycle all water used in cleaning operations. Coordinate with Engineer of Record to determine current local requirements.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material for repairing brick masonry (brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 BRICK MASONRY MATERIALS

A. Face (Veneer) Brick and Accessories: Provide face brick and accessories where required to complete masonry restoration work.

1. Provide units with color, surface texture, size, and shape to match cleaned examples of existing brick.
2. Grade SW, Type FBX; unless directed otherwise by the Engineer of Record.

B. Building Brick: Provide building brick complying with ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.

1. Grade SW; unless directed otherwise by the Engineer of Record.

C. Brick Suppliers:

1. Belden Brick Sales & Service, Inc.
2. Glen Gery Brick
3. Tri-State Brick & Building Materials, Inc.

2.3 MASONRY REPAIR REINFORCEMENT AND ANCHORS:

A. Provide hardware from one of the following manufacturers/suppliers:

1. Lateral Brick Ties:

a. Basis of Design: “2-Seal Thermal Concrete Wing Nut Anchor” by HOHMANN & BARNARD

2. Column Anchors:

a. Basis of Design: “353/355 Column Anchors” by HOHMANN & BARNARD.

3. Weeps

a. Basis of Design: “343 Weep Hole” by HOHMANN & BARNARD, sized to match brick head joints.

b. “342 W Rectangular Plastic Weep Holes” may also be used.

4. Control Joints

a. Basis of Design: “Slip Set” stainless steel stabilizers by HOHMANN & BARNARD.

5. Lintel Repair:

a. Basis of Design: “HeliBar” and “HeliBond” by LEVIAT , makers of “Helifix” Brand masonry products.

6. Crack Stitching:

a. Basis of Design: “HeliBar” and “HeliBond” by LEVIAT , makers of “Helifix” Brand masonry products.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray where required for color matching of existing mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate for Mortar: ASTM C 144, unless otherwise indicated.

1. For pointing mortar, match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

2. Use natural or manufactured sand selected to replicate original aggregate, and to produce mortar color indicated.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in stone mortars. Match historic mortar color based on laboratory analysis of samples (to be provided to Contractor by Engineer of Record) and existing original material still in place after it has been cleaned.

E. Water: Potable, pH between 6.75 and 7.25, without noticeable color.

2.5 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Engineer of Record's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:
1. Setting Mortar by Volume: ASTM C 270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime.
a. 1 part Portland cement : 1 to 1-1/4 parts hydrated lime : 4.5 to 6 parts sand of character and grading consistent with the original mortar.
2. Pointing Mortar by Volumn: ASTM C 270, Proportion Specification, Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
3. 1 part Portland cement : 1.5 to 2.5 parts hydrated lime : 6 to 9 parts sand of character and grading consistent with the original mortar.
a.
4. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, pointing mortar of colors required.

2.6 REPLACEMENT STEEL LINTELS

A. Angle Shapes: ASTM A 276/A276M-15.

2.7 FLASHING

A. Sheet Metal Flashing

1. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 temper; coated on both sides with zinc-tin alloy (50 percent zinc, 50 percent tin).
2. Basis of Design: “Freedom Gray” by Revere Copper. 20 oz.. per sf.
3. Wall and Lintel Flashing: Fabricate continuous flashings in 96-inch- (2400-mm-) long, sections, under parapet walls and over steel lintels. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams.

B. Butyl-based Self-Adhering Sheet Flashing: synthetic butyl laminated to a polypropylene film. 19 mils minimum thickness, widths as required for specific applications.

1. Basis of Design: “Blueskin Butyl Flash” by the HENRY COMPANY.

2.8 FINAL WASHDOWN CLEANING SOLUTIONS

A. Provide the following types of cleaners and accessories from one of the following approved manufacturers: ProSoCo, Inc.; Diedrich Technologies, Inc.; ABR Products, Inc; Dumond Chemicals, Inc.

1. Final Clean Down: Acidic cleaner specifically formulated to prevent staining due to manganese and other inclusion in brickwork:
2. Basis of Design: “Sure Klean VanaTrol” by PROSOCO.
    a. Use “Sure Klean Strippable Masking” over existing windows during washdown procedures.

PART 3 - EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
2. Protect existing window panes and frames from contact with masonry materials. Use polyethylene sheeting and masking to prevent staining as well as passage of air-borne dust to the interior.
3. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
4. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

3.2 BRICK REMOVAL AND REPLACEMENT

A. Carefully remove, at locations indicated, bricks that are damaged, spalled, or deteriorated, or that are otherwise scheduled for removal. Cut out full units from joint to joint and in a manner to permit replacement with full-size units without damaging surrounding masonry.

B. Support and protect remaining masonry that surrounds removal area. Maintain header courses, reinforcement, lintels, and adjoining construction in an undamaged condition.

C. Clean remaining brick at edges of removal areas by removing mortar, dust, and loose particles in preparation for replacement.

D. Prepare and obtain approval of field samples.

E. Install new brick to replace removed brick. Fit replacement units into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry leaving clean, sharp, unchipped edges.

F. Lay replacement brick with completely filled bed and head joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet clay bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g per 30 sq. in. per min. (30 g per 194 sq. cm per min.). Use wetting methods that ensure units are nearly saturated but surface dry when laid. Maintain joint width for replacement units to match existing units.

1. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry.

3.3 REPOINTING MASONRY

A. Raking Joints:

1. For Walls with Average Joint Width between 3/8" and 1/2" wide , and with less than 20% variation in Joint Width:
    a. Rake out mortar from joints to depths equal to 2-1/2 times their widths, but not less than 3/4 inch (19 mm) or not less than that required to expose sound, unweathered mortar.
2. For Walls with Average Joint Width greater than 1/2" wide, or with width variation 20% or greater between joints:
    a. Rake out mortar from joints to depths equal to joint width, but not less than 3/4" or that required to expose sound, unweathered mortar.
3. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris. Do not spall edges of masonry units or widen joints. Replace damaged masonry units.
    a. Do not use power-operated grinders without Engineer of Record’s approval based on demonstrated ability of operators to use tools without damaging masonry. Contractor shall submit a quality-control program describing provisions for supervising performance and preventing damage due to worker fatigue.
    b. Provided competence is demonstrated, 4" rotary grinders may be used to remove mortar from the middle of bed joints of sufficient width to avoid striking the brick with the grinder, and to remove mortar from the middle of head joints provided no damage occurs to bricks on either side or above or below. Note: grinders must be equipped with dust-control devices. Remove all remaining mortar from the arrises and faces of the brick using hand chisels and other approved hand tools. Remove all mortar from the intersections of head and bed joints with hand tools.

B. Pointing Joints:

1. Rinse masonry-joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at the time of pointing, excess water has evaporated or run off and joint surfaces are damp but free of standing water.
2. Repoint all joints in no fewer than three "lifts" of replacement mortar.
3. Apply in layers not greater than 3/8 inch (9 mm) until a uniform depth is formed. Compact each layer thoroughly and allow it to become thumbprint hard before applying the next layer.
4. Where existing bricks have rounded edges, slightly recess final layer from face. Take care not to spread mortar over edges onto exposed masonry surfaces or to featheredge mortar.
5. End each session's pointing along the bed joints and away from head joints. Do not stop work at head joints.
6. When mortar is thumbprint hard, tool joints to match original appearance of joints, unless otherwise indicated. Remove excess mortar from edge of joint by brushing.
7. Cure mortar by maintaining in a damp condition for at least 72 hours.
8. Allow mortar to harden at least 14 days before beginning final washdown work.

3.4 STAINLESS STEEL REINFORCEMENT

A. Lintel Repair and Crack Stitching: follow manufacturer's instructions regarding preparation, mixing and placement of the reinforcement.

1. Cut slots into horizontal mortar joints to a depth of 1-1/2" to 2" and the full height of existing mortar joints. Remove as much mortar from edges of each slot as possible.
2. Clean all dust and loose mortar and thoroughly flush with water.
3. Inject a ½" deep bead of manufacturer's cementitious grout against the back of the slot.
4. Push the first manufacturer's stainless steel bar into the grout.
5. Inject a second bead of grout over the first bar to cover.
6. Push the second stainless steel bar into the grout.
7. Inject a third bead of grout over the second bar and tool this grout against the second bar so as to leave no voids between or around bars.
8. Add additional grout and tool with a roughened face approximately ½" recessed from the face of brick.

B. Other hardware: install anchors and other masonry accessories as required by Code, indicated on Project drawings, and as required. Follow manufacturer's instructions regarding use of each component.

3.5 SHEET METAL FLASHINGS

A. Install sheet metal flashing to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install sheet metal flashing true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder.
2. Anchor sheet metal flashing and other components of the Work securely in place, with provisions for thermal and structural movement.
3. Install sheet metal flashing to fit substrates and to result in watertight performance.
4. Install exposed sheet metal flashing with limited oil-canning, and free of buckling and tool marks.
5. Do not field cut sheet metal flashing by torch.

B. Expansion Provisions: Provide for thermal expansion of exposed flashing.

1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

C. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Do not pretin zinc-tin alloy-coated copper.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder using soldering irons, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

3.6 BUTYL-BASED FLASHING

A. Surfaces to receive flashing must be dry, clean and free of sharp protrusions. Surfaces must be free of large voids.

B. Prime surfaces to receive the flashing using the manufacturer's recommended cleaner/primer.

C. Position flashing for alignment with the release paper in place. Peel away release paper and press firmly into substrate. Roll entire surface with a stainless steel roller. Completed installation should be free of wrinkles or blisters; there shall be NO "fishmouths" or other gapping along the edges of the flashing.

D. Tool edge sealant over all exposed edges of the flashing and allow to cure prior to closing in with masonry.

3.7 FINAL CLEANDOWN

A. Apply mild acidic cleaner following manufacturer's written instructions. Allow minimum of 14 days curing to pass prior to commencing final washdown. Perform sample test cleaning on area of 16 sf before proceeding

B. Perform all work when temperatures are 40 degrees F and above.

C. Dilute 5-10 parts water to 1 part concentrate. Adjust dilution rate based on test results.

D. Saturate masonry surfaces with fresh water, working from bottom to top.

E. Apply diluted solution freely over masonry surfaces, using soft bristle brushes or low pressure spray.

F. Allow dilution to remain on the wall for approximately 5 minutes. DO NOT LET CLEANER DRY into the masonry.

G. Use wood scrapers to assist in removal of heavy mortar buildup.

H. Do not reapply dilution. If mortar deposits are not softened after the initial application, allow the solution to remain on the wall for a longer period, making sure cleaner does not dry into the masonry.

3.8 Rinse thoroughly with fresh water, working from the bottom to top.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Inspections and Tests:

1. Testing Prior to Construction: One set of tests.

2. Testing Frequency During Construction: One set of tests weekly throughout duration of construction.
3. Testing Set:
    a. Mortar Aggregate Ratio Test per ASTM C780.
    b. Prism Test: per ASTM C1314 at 7 days and 28 days.

C. Engineer of Record's Project Representatives: Engineer of Record will assign Project representatives to help carry out Engineer of Record's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Engineer of Record's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

D. Notify [inspectors] [and] [Engineer of Record's Project representatives] in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until [inspectors] [and] [Engineer of Record's Project representatives] have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.10 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 040120

SECTION 042200 – CMU MASONRY

PART 1 - GENERAL

1.1 Contract Documents

A. Comply with Contract Documents:

1. All Work of this Section shall comply with the requirements of the Conditions of the Contract (General, Supplementary and Special), with all Sections of Division 1 - General Requirements, with this Section, with the Drawings and with all other Contract Documents.

1.2 Work Included

A. Provide all labor, materials, equipment and services and perform all work of this Section and related work indicated on the Drawings and specified herein, including, but not limited to the following:

1. Face brick to match existing to the satisfaction of Architect for patching existing face brick
2. Concrete block units for drug vault walls..
3. Mixing and using mortar for all masonry work.
4. Grouting, patching and cleaning all masonry work.

1.3 Related Work

A. Related work specified under other sections for of the Specifications.

1. 040110 - BRICK MASONRY CLEANING
2. 040120- BRICK MASONRY REPAIR

1.4 Quality Assurance

A. The finish, texture and color of the approved sample shall be the standard of quality for this project.

B. All masonry work shall be installed by workman skilled in the trade and in a workmanship like manner.

C. All materials furnished under this Section shall comply with the appropriate ASTM number designation specified under PART 2 PRODUCTS.

1.5 Submittals

A. See spec section 040120- BRICK MASONRY REPAIR for required brick samples.

B. Certificate

1. Provide certification and test reports indicating that face brick furnished meet or exceed ASTM Designation C216-87 Standard specification for Facing Brick, Grade SW, Type FBS.

C. Substitutions

1. If Contractor wishes to make a substitution, Contractor shall bear all costs associated with the application.

1.6 Delivery, Storage and Handling

A. Deliver all material, in manufacturer's original unopened containers, bearing the manufacturer's name and type of object.

B. Block and Brick Units shall be delivered dry and within the allowable moisture content limitations. Stack on pallets off the ground and cover with tarpaulins or other approved protection in such manner to allow for circulation.

C. Metal anchors, ties, reinforcement and the like shall be stored in such manner as to prevent bending, deformation and rusting.

D. All materials shall be handled with care to prevent damage of any kind. Damaged materials shall be removed from the site, replaced with new at no additional cost to the Authority. The Authority and Authority's Representative shall have access to all Storage Areas.

E. Masonry units of all nature shall be handled to prevent undue chipping or breakage. Surface of masonry not being worked on shall be properly protected at all times during construction operations.

1.7 Job Conditions

A. No masonry shall be erected when the temperature is 32°F and falling unless adequate provisions are made for heating the materials and protecting the work by providing and maintaining the temperature above 40°F during an for not less than 48 hours subsequent to lay-up. No antifreeze admixtures will be allowed. No exposed masonry shall be erected when the temperature is above 90°F. Surfaces of all masonry not being worked on shall be properly protected at all times during the construction operations.

B. No frozen work shall be built upon or will be accepted. Masonry units having a film of frost on their surfaces shall not be used. All masonry shall be laid plumb, true to line and level with accurately spaced courses and reveals. All masonry shall have corners plumb and true with each course breaking joint with the course below except as may be otherwise indicated or specified. Bond shall be kept plumb throughout. Work on the Contract and other Contracts and trades required to be built in with the masonry, including anchors, wall plugs, accessories, etc., shall be built in as the work progresses.

C. Unfinished work shall be stepped back for joining with new work. Before new work is started all loose mortar shall be removed and exposed joints thoroughly wetted not less than 12 hours before laying new work.

PART 2 - PRODUCTS

2.1 Materials

Architect : Bernstein & Associates, Architects
M/E Engineer : ME Engineers
Structural Engineer : Geiger Engineers

A. Face Brick: See spec section 040120- BRICK MASONRY REPAIR

B. Concrete Masonry Units: Concrete masonry units shall be lightweight. Aggregates shall be 100% expanded shale, clay, or slate produced by the Rotary Kiln method complying with ASTM C-331, and shall be graded (#4-0 gradation, Table 1 of ASTM C-331) to assure constant texture. The blending of screenings or any other deleterious substance which will impair the fire rating or insulation values of the unit is prohibited. All block to be exposed or to receive painted finish shall have a fine grain texture.

1. Concrete masonry unit nominally 8" or more in thickness shall be hollow load bearing meeting the requirements of ASTM C-90-90.

2. Density: The oven-dry density of concrete shall not exceed 90 lbs. per cubic foot.

3. The producer of the concrete masonry units shall furnish certification from an independent testing laboratory confirming that all 8" or larger masonry units meet all of the UL-618 requirements for two (2) hours or better (as required), referencing full scale fire test reports (ASTM E-119), all 4" and 6" units shall conform to National Bureau of Standards and National Research Council full scale fire tests.

4. Masonry units shall be manufactured not less than thirty (30) days before installation and shall be stored under cover until shipment. Furnish all new masonry. No existing masonry shall be reused.

PART 3 - EXECUTION

3.1 General

A. Do not install cracked, broken, or chipped masonry units exceeding ASTM allowances.

B. Material shall be accurately laid out so as to require minimum amount of cutting of standard units.

C. Use masonry saws to cut and fix exposed units.

D. Lay units plumb, true to line, and with level courses accurately spaced.

E. Do not furrow bed joints.

F. Stop off horizontal run by racking back in each course, toothing is not permitted.

G. Adjust units to final position while mortar is soft and plastic.

H. If units are displaced after mortar has stiffened, remove, clean joints and units of mortar and relay with fresh mortar.

I. Build in all loose lintels, anchors, ties, bolts, sleeves, etc., as required under all Specifications Sections.

J. Where reinforcing bars, anchors, etc. occur within cores of masonry units, such cores shall be filled with mortar.

K. Include expansion joints and control joints as detailed or as required by conditions in the field.

3.2 Installation

A. Masonry Block Units

1. Each course of masonry units shall be solidly bedded in mortar with vertical joints breaking halfway over the course below for "running bond" construction. All joints shall be 3/8" thick. Units shall be bonded at corners and intersections by an alternate lapping of units, and shall be bonded into or anchored to the adjacent construction. No cells shall be left open in face surfaces.

2. Units shall be laid out vertically in such a manner that units less than 1/2 height of normal blocks will not show. Units shall be built up tight to beam soffits and underside of floor slab or roof deck above, wedged in tight with slate or brick and joints filled with mortar.

3. Units shall be laid in prefect alignment. Exposed faces of work shall have joints tooled with round steel or glass pointing tool to a dense, smooth, slightly concave uniform profile. Horizontal joints shall continue at the same elevation from the floor in each room or spaces where blocks are exposed to view.

4. Galvanized steel wire wall reinforcement shall be placed in all masonry block walls, partitions and furring, irrespective of whether or not blocks are to receive plaster or are to be exposed on the finished work. Reinforcement shall be bedded in every third horizontal joint, continuous for full length of the joint. Reinforcement shall also be installed in the first course above and below openings extending 6" beyond each side of the opening.

B. Face Brick: See spec section 040120- BRICK MASONRY REPAIR

3.3 Cleaning and Pointing: See spec section 040120- BRICK MASONRY REPAIR

END OF SECTION 042200

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Description of Work.

1. All steel framing.
2. Prime painting of steel where specified.
3. Erection of all steel components.
4. Supply and installation of all metal deck per Division 05310 “Steel Deck”
5. All welds to the steel work covered in this section, including tack welds and/or welds of attaching material or components not covered in this section.

B. Responsibilities of Contractor

1. The Contractor shall provide all the structural steel, including transport to the site.
2. The Contractor shall erect all the structural steel.
3. The Contractor shall provide all painting of the steel, including field touch up.
4. The Contractor shall be solely responsible for the safe execution of the work in the shop and in the field.
5. The Contractor shall be responsible to coordinate the work with that of all other trades, including locating, detailing and fabricating penetrations through steel members for other work.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.
2. Division 5 Section "Steel Deck" for metal floor and roof decking and accessories
3. Division 9 Section "Special Coatings" for surface preparation and priming requirements.

1.3 .SUBMITTALS

A. General:

1. Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

2. The Architect shall review the Contractor's submittals for general compliance with the Contract Documents for strength and serviceability only, this review shall not be for accuracy of dimensions, fit-up, constructability, or for coordination of shop drawings.

B. Product Data for each type of product specified.

C. Shop Drawings Detailing fabrication of structural steel components. The Contractor shall submit shop drawings to the Architect for review in accordance with the General Conditions of the Contract. The Contractor shall budget sufficient time in his schedule to allow for the Architect's review of shop drawings. The Architect's review shall be conducted as timely as is possible under the circumstances, but the Contractor shall allow on average for shop drawing submittals to remain in the Architect's possession an average of 10 working days for shop drawing review. The Contractor shall allow for longer review periods for submittals of above average complexity, when extensive design calculations are part of the submittal or when many drawings are submitted together.

D. The Contractor should allow in his schedule for the likelihood that some shop drawing submittals will have to be submitted more than once for review of the Architect.

1. Shop drawings shall be carefully checked by the Contractor before being submitted to the Architect for review, and shall be submitted in the order in which they are needed for the execution of the work, not all at once, to a schedule previously agreed with the Architect, but at least four,4, weeks prior to fabrication. Submitted drawings shall show all structural steel required for the work, whether or not indicated on the Contract Drawings.
2. Submit the required number of copies of all shop drawings to the Architect. The Architect will return, marked with his comments, one sepia of each shop drawing to the Contractor. Submit sufficient copies of final versions of drawings and other submittals for distribution to all parties.
3. The Contractor shall immediately make all corrections to his drawings as noted by the Architect in his review, or as required by changes ordered or authorized by the Owner. The Contractor shall keep a satisfactory history of all changes by noting all revisions with separately numbered and dated revision notes on a convenient portion of each drawing affected. Specific changes on a revised drawing shall be clouded so as to bring the revisions to the attention of the Architect. The pertinent revision number and date shall be prominently displayed on each drawing. Changes to revised drawing submittals shall be highlighted so that the changed portion of the drawing is distinguished from the balance of the information.
4. The shop drawings shall clearly identify all steel surfaces, which are to be painted.
5. The shop drawings shall show all shop and erection details including cuts, copes, camber, connection holes, threaded fasteners, bolts, studs and spacing, etc.
6. Shop drawings shall clearly identify all material types, grades, etc.
7. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.
8. The shop drawings shall show all welds, both shop and field, by the currently recommended AWS symbols and show size, length, and type of each weld.
9. The Contractor shall not fabricate any material until after the Architect's review of erection plans and detail sketches nor proceed with any work for which such drawings are required until they have been reviewed by the Architect. Erection drawings shall be submitted for review first. Detail shop drawings shall not be submitted until the erection plans have been reviewed and returned by the Architect.

10. Erection plans and drawings shall be drawn to a scale no smaller than 1/20"=1'-0" with section and detail sketches to a larger scale. Erection drawings shall clearly identify all piece marks to be utilized to identify the separate components of the structure. Erection drawings shall include details of all temporary connections to other parts of the structure, contractor designed or supplied erection fittings, sequence of erection, shores, towers, and other pertinent information.
11. Prepare and submit layout and installation drawings of all anchor bolts and other items to be embedded in concrete work by others. Drawings shall dimension the locations of all embedded items noting pertinent tolerances for the installation. Such drawings shall be submitted no later than four, 4, weeks following the contract start date.
12. Update all shop and erection drawings as required through the fabrication and erection of the work. Upon completion of erection, submit "as-built" drawings to the Architect for record purposes.
13. Include Shop Drawings signed and sealed by a qualified professional engineer, licensed in the state of New York and responsible for their preparation.

E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.

1. Structural steel, including chemical and physical properties.
2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
3. Shear stud connectors, including data demonstrating qualification of stud bases per AWS D1.1 Appendix IX
4. Welding Electrodes and other consumables.
5. Shop primers.
6. Non-shrink grout.

G. Proofs of Compliance:
1. The Contractor shall furnish a certificate from the producers of all material, steel and fasteners, certifying that the material meets the minimum requirements specified.

H. Submit details of proposed method of piece marking the steel components for identification and verification of proper placement in the work. Marks shall be placed in positions, which can be checked after erection.

I. Weld Procedures and Sequences:
1. Submit, for record purposes only, all weld procedures and weldment weld sequences. Weld procedures and sequences shall be prepared by the fabricator in accordance with the requirements of AWS D1.1 and submitted for the record as demonstration of compliance with the provisions of AWS. Weld procedures and sequences will not be reviewed for technical content by the Architect and will not be returned to the Contractor. Submittal of this material shall in no way diminish the Contractor's sole responsibility for the determination of appropriate means, methods, sequences and procedures for the welding work.

J. All work indicated and/or specified on shop drawings and other required submittals shall be deemed to be within in the scope of the Contract, unless specifically noted otherwise. The

Architect's and the Engineer of Record's review and acceptance of shop drawings and all other submittals which show, specify or otherwise indicate work which is deemed additional to the scope of the work shall in no way entitle the Contractor to additional compensation.

1.4 QUALITY ASSURANCE

A. Installer/Erector Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

C. Codes and Standards:

D. Work must comply with the latest edition of the following standard specifications and codes with modifications as specified herein:

1. New York State Building Code
2. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
3. AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."
4. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
5. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."
6. AISC's "Seismic Provisions for Structural Steel Buildings."
7. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
8. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
9. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
10. American Welding Society - "Structural Welding Code ANSI/AWS D1.1-00".
11. American Welding Society - "Structural Welding Code , Reinforcing Steel, ANSI/AWS D1.4 -94"
12. American Welding Society - "Recommended Practices for Stud Welding, ANSI/AWS C5.4"
13. Steel Structure Painting Council - Painting Manual, Vol. 1 and 2.
14. American Society for Testing and Materials (ASTM) - as referenced herein.
    In the event of conflict between any of the pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

E. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the state of New York, and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

F. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

1. Qualify processes and welding operators in accordance with AWS "Standard Qualification Procedure".
   a. Provide certification that welders to be employed in the work have passed AWS qualification tests in the for the positions, weld types, techniques and equipment they will be using in the work , and are currently certified. Submit original signed certificates to the Architect.
   b. If re-certification is required, retesting is the Contractor's responsibility.

2. 2. Qualify processes, procedures and operators for all stud welding pursuant to AWS D1.1 Sections 7.6 and 7.7.

G. Testing and Inspection of Steel Work: Testing and inspection of the structural steel for the Owner's quality assurance will be performed by an independent Testing Agency, retained and paid for by the Owner. The Contractor shall not rely on the Owner's Testing Agency for his quality control.

1. The Contractor shall furnish to the Testing Agency, as part of the cost of the Work, the following:
   a. A complete set of approved erection drawings and shop drawings.
   b. Cutting lists, order sheets, material bills and shipping bills and schedules.
   c. A complete set of all welding procedures and sequences prepared in accordance with AWS requirements.
   d. Information as to time and place of all rolling and shipment of material to shops.
   e. Representative sample pieces required by the Testing Agency for testing.
   f. Full, safe, and ample means and assistance for testing all material and proper facilities and access, including scaffolding, temporary work platforms, etc. for inspection of the work in the shop and in the field.
   g. Current certificates for all welding operators.
   h. A copy of the fabrication shop's quality control procedures manual.
2. The Architect and the Testing Agency Inspector shall have the privilege of inspecting the work in the shop or field any time during the period of fabrication or erection. The Architect and the Testing Agency Inspector shall have the privilege to take photographs of the Work for documentation.
3. The Inspector shall review the material and workmanship of steel, both in the shop and field, for general compliance with the Contract Documents and steel shop drawings. He shall test welded and bolted connections as outlined below. The Inspector shall record types and locations of all defects found in the work and measures required and performed to correct such defects.
   The Contractor shall make all repairs to defective work to the satisfaction of the requirements of the Contract Documents and at no additional cost to the Owner.
4. The Inspector shall submit reports of his inspection and test findings to the Architect, and the Owner or his representative. He shall record all defects found with subsequent repair operations and submit reports to the Architect.
5. The work of the Inspector shall in no way relieve the Contractor of his responsibility to comply with all requirements of the Contract Documents, nor shall the work of the Inspector relieve the Contractor's responsibility for quality control of the work either in the shop or in the field.
6. Testing and Inspection of Welding. The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
   a. All welds shall be visually inspected by the Inspector.

b. In addition to visual inspection, the welded connections shall be inspected and/or tested by non-destructive testing methods by the Testing Agency as follows:

All welds shall be non-destructively tested at a rate of one in four completed by each welder except as follows:

Every complete penetration weld, such as groove, bevel and butt welds, shall be tested. All partial penetration groove and bevel welds shall be tested. If after 20 tests of any particular type of weld, the failure rate is less than 10%, the testing sample rate may be reduced to every other weld.

Non-destructive test methods shall include the following:

Ultrasonic procedures for complete penetration and/or groove welds. Radiographic procedures may also be used for some of the complete penetration weld testing where either the Owner or the Testing Agency desires a permanent record of the weld test.

Ultrasonic methods for tee or corner welds.

Magnetic particle testing for fillet welds.

c. When requested, submit specimens of welded joints and weld metal to the Testing Agency for testing.

7. Testing and Inspection of High Strength Bolts, (A325 and/or A490). The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
   a. Material: The testing agency shall randomly select bolts for testing at a rate of one per one thousand, and shall test for all requirements of ASTM A325 or A490; including, but not limited to, chemical composition, hardness, dimension, and tensile strength.
   b. Pretension of Bolts in Slip Critical Connections: The testing agency shall review installation of all bolts in Slip-Critical Connections per the requirements of the AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Slip-Critical Connections will be specifically identified on the Drawings.
8. Testing and Inspection of Welded Studs. The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
   a. Pre-production Testing: The testing agency shall review the Contractor's pre-production testing. The Contractor shall perform this testing at his expense per AWS D1.1 Section 7.7.
   b. The testing agency shall conduct testing per AWS D1.1 Section 7.8.

H. Prefabrication/Preinstallation Conference:
1. Prior to commencement of fabrication, arrange a meeting at the fabricator's shop with the General Contractor, the Architect, and the Testing Agency Inspector to review the shop's quality control procedures, welding procedures, welding sequences for complex weldments, and the general schedule for fabrication work.
2. Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.6 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

1.7 REJECTION AND REPLACEMENT:

A. In the event of damage to the steel, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

B. Any materials or welding rejected by the Architect or the Testing Agency Inspector either in the shop, mill or field including bolts and other purchased items, must be promptly repaired or replaced to meet the requirements of the Contract Documents at no additional cost to the Owner.

1.8 SUBSTITUTIONS:

Any proposed alternate member sizes, steel grades, connection details or other modifications shall be considered only when each request has been made prior to the submission of shop drawings, and under the following circumstances:

A. All pertinent sketches engineering calculations and schedules are submitted with the request, for review per the provisions of paragraph 1.7, and either:
1. The proposed substitution is shown to be necessary in procuring specified materials, and/or is also vital to meeting project schedule deadlines, or
2. A substantial cost savings may be assumed by the Owner.

B. Such requested revisions shall only be accepted if they are made prior to the submission of shop drawings. The acceptance of shop drawings showing Contractor substitutions that have not been given prior acceptance by the Architect shall not constitute acceptance of the substitution by the Architect, Engineer of Record or the Owner.

Shop drawings submitted by the Contractor showing substitutions, for which prior acceptance has not been granted, shall be subject to rejection.

C. The Contractor shall be responsible to fully reimburse the Owner for all costs associated with the Architect's review and evaluation of requests for substitutions and changes. A submission of a substitution request by the Contractor shall be deemed to constitute authorization of the Owner to take amounts required to pay for the Architect's review of the proposed substitution from amounts owing the Contractor.

D. All substitutions must also comply with the requirements elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wide Flange shapes : ASTM A992 , Fy min=50 ksi.

B. Structural Steel Plates and Bars, channels and rods : ASTM A 36 (ASTM A 36M) , Fy min=36 ksi.

Special care shall be used to select plate and rolled sections free from internal laminations where through thickness tensile stresses may be induced. The contractor shall assure compliance with BOCA provisions 1705.3.3.2.3

C. Cold-Formed Structural Hollow Square and Rectangular Sections (Structural Steel Tubing): ASTM A 500, Grade B, Fymin=46 ksi.

D. Structural Round Sections (Steel Pipe): ASTM A 53, Type E or S, Grade B, Fymin=35 ksi.

E. Rolled Sections for Ledger Angles and Masonry Lintels indicated on the Structural Drawings as A36 shall conform to ASTM A-36. All such members supporting masonry in the exterior building wall assembly shall be hot dipped galvanized. Other ledgers and lintels not called out on the 'S' Drawings are specified in Specification Section 05500.

F. Shear Connectors:
1. Shear Connectors shall be ASTM A 108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B Table 7.1. Fy min=50 ksi
2. All Steel Studs shall be at least 0.75 inch (19 mm) diameter unless specifically noted otherwise on the Drawings.
3. All Steel Studs shall be headed studs of the diameter and length indicated on the Drawings. All steel studs shall have meet the requirements of the AISC "Specification for Structural Steel Buildings- Allowable Stress Design and Plastic Design" for use in composite construction. The minimum allowable shear load for studs shall be per Table I4.1 in the AISC "Specification".
4. All Steel Studs shall be welded and shall have qualified bases per AWS D1.1 Appendix IX.

G. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Unheaded Rods: ASTM A 36 (ASTM A 36M).

2. Headed Bolts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.
3. Washers: ASTM A 36 (ASTM A 36M).

H. Non-high-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.

I. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.

J. Welding Electrodes: Comply with AWS requirements.
1. Welding electrodes shall be E70XX, low hydrogen for all connections of all material

2.2 PRIMER

Prime Paint must be compatible with finish paint specified in Division 9.

A. Primer: Supply zinc rich prime paint for all steel which is not exposed to weather. Prime Paint must be suitable as a stand alone paint. All other steel is to receive shop paint per the requirements of Architectural Exposed Finishes. All other steel is to receive shop paint per the requirements of Architectural Exposed Finishes. Where there is doubt as to whether steel surfaces are exposed to weather, assume that they are.

B. Primer: Zinc Clad III moisture cured zinc rich primer. Commercial blast to SSPC-SP6.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

2.3 GROUT

A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Metallic, Shrinkage-Resistant Grout: Premixed, factory-packaged, ferrous aggregate grout, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

C. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time. Minimum grout strength at 28 days shall be f'c=6000 psi

2.4 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.

1. All members when finished shall be true and free of twists, bends, and open joints between the component parts. Members shall be thoroughly straightened in the shop by methods which will not injure them, before being worked on in any way.

2. Camber structural steel members where indicated.
3. Identify high-strength structural steel according to ASTM A 6 (ASTM A 6M) and maintain markings until steel has been erected.
4. Member splices between workpoint connections are not permitted except where specifically shown on the Drawings.
5. Connections:
   a. Connections shall be as indicated on the Drawings. One-sided or other type of eccentric connections shall not be used except where indicated on the Drawings.
   b. Combination of bolts and welds in a connection of any two components will not be utilized, unless otherwise shown on the Drawings.
   c. Field connections shall be bolted, unless otherwise detailed. The high strength bolts used shall have a suitable identifying stamp placed on top of the head before leaving the factory.
   d. Bearing Joints, where abutting surfaces rely upon direct bearing for transmission of load, shall be milled or otherwise suitably prepared to ensure full and even bearing at joint interface.
   e. Plates which are subjected to axial tension shall be oriented with the roll direction as shown on the Drawings. Where not shown orient the roll direction nominally parallel to the direction of primary tensile stress in the plate.
6. All members and weldments shall be piece marked with metal tags adhered or welded to the piece. Submit details of marking per specification paragraph 1.4,L.
7. Hollow Structural Members: All hollow structural members, round and/or tubes, shall be completely sealed airtight with welded plates (allow a ¼" (25mm) ϕhole for pressure relief or other approved method of sealing.
8. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
9. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
10. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Thermal Cutting (Oxygen Flame Cutting) Perform thermal cutting by machine to greatest extent possible.
1. Manual oxygen cutting shall be done only with a mechanically-guided torch. Alternatively, an unguided torch may be used provided the cut is not within 0.5", (15 mm) of the finished dimension and the final removal is completed by chipping or grinding to produce a surface quality equal to that of the base metal at cut edges.
2. Control process to prevent excessive hardening of edges of steel where material is to be welded or is subject to axial tension.
3. Clean and repair all cut edges by welding and/or grinding to remove all gouges, cuts burrs and jags to meet the requirements of AWS D1.1.
4. Re-entrant cuts shall have as large a radius as possible without over cutting.
5. The use of oxygen-cut holes for bolted connections will under no circumstances be permitted, and violation of this clause will be sufficient cause for the rejection of any pieces in which oxygen cut holes exist.

6. Oxygen cutting of structural steel in the field is not allowed except with the written consent and approval of the Architect.

C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's printed instructions.
1. Steel Studs for Composite Construction with Metal Deck shall be installed per the detailed provisions of the AISC Manual Section I5.
2. Other steel studs, such as those welded to embedment weldments shall be arranged as shown on the Drawings.

E. Steel Wall Framing: Select true and straight members for fabricating steel wall framing to be attached to structural steel framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

F. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.5 SHOP CONNECTIONS

A. All bolt holes shall be either drilled or reamed. Where ever possible, all plies to be bolted in a connection should be drilled or reamed together and then match marked. Assure fit-up of the bolt pattern at connections in the field.

B. Shop install and tighten non-high-strength.

C. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts, Assume high strength bolts are to be used except where non-high-strength bolts are indicated.

1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
2. Bolts: ASTM A 490 (ASTM A 490M) high-strength bolts, unless otherwise indicated.
3. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
4. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.
5. Recommended procedure for installing assembling bolt groups:
   a. Assemble joint using drifts to obtain correct alignment.
   b. Fit bolts. Use hardened washers under the turned part. Lubricate bolts to prevent nuts seizing on the bolts. Lubricate with a liquid high pressure lubricant and apply only to the outstanding threads after the bolts have been inserted through the steel work, taking care to prevent lubricant getting between the plies of the joint.
   c. Tighten bolts sufficiently in an appropriate sequence to bring joint surfaces into uniformly close contact.

d. Where indicated pretension bolts to the appropriate levels using load indicator washers, turn-of-the-nut, or other suitable means. If turn of the nut method of pre-tensioning bolts is used, demonstrate to the satisfaction of the Testing Agency that the desired bolt tensions are achieved for the various combinations of bolt sizes, lengths and connection plies.
e. Mark each bolted connection when all bolts in the connection are pre-tensioned. Do not touch-up paint until bolts have been inspected by the Testing Agency. The Testing Agency will mark connections which have been inspected.

D. Weld Connections:
1. Operators - Welds will be made only by operators who have been previously qualified by tests, as prescribed AWS D1.1 to perform the type of work required.
2. All welders involved in the Work will be assigned an identifying symbol or mark. Each welder will be required to mark or stamp his symbol on each weldment completed for identification. The Contractor shall maintain a record of welders employed, date of qualification and symbol or identification mark assigned to each.
3. Welding equipment shall be of sufficient capacity and maintained in good working condition, capable of adjustment in a full range of current settings. Welding cables shall be of adequate size for the currents involved and grounding methods shall be such as to ensure proper machine operation.
4. No welding shall begin until joint elements are clamped in proper alignment and adjusted to dimensions shown on the drawings with allowance for any weld shrinkage that is expected. Welding procedures sequences shall be such as to minimize residual stresses and distortion.
5. Heavy sections and those weldments having a high degree of restraint must be welded in a sequence with the proper preheat such that no permanent distortion or undue residual stress occurs.
6. Field welding shall in general not be permitted and shall be done only when shown on the Drawings. Where field welding is acceptable, all standards for shop welding, including rod drying and pre-heat temperatures, shall apply, except as noted. All field welds shall be inspected by the Owner's Testing Agency using suitable non-destructive testing methods.
7. All welding shall be done in accordance with the reference specifications, with the following modifications and additions:
   a. All shop welding shall be done by either submerged arc welding, flux-core, or manual shielded metal-arc welding pursuant to the requirements of AWS D1.1, or other welding process approved by the Architect.
   b. All field welding, where allowed, shall be performed by manual shielded metal-arc welding to AWS D1.1.
   c. All groove and butt welds shall have complete penetration unless otherwise specified on the Drawings.
   d. The minimum preheat and interpass temperatures shall be maintained during all welding operations per AWS D1.1.
   e. Heavy sections and those weldments having a high degree of restraint must be welded in a sequence with the proper preheat such that no permanent distortion occurs. Submit a welding sequence for review for these types of connections.
8. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
9. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface

bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

2.6 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 3 inches (76 mm).
2. Surfaces to be field welded. Do not paint within 2 inches (51mm) of field welds
3. Faying surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed-on fireproofing.
5. Galvanized surfaces.

B. Minimum Surface Preparation: Thoroughly clean all steel surfaces (whether to receive paint or not) of all loose mill scale, loose rust, spatter, slag and flux deposit, oil dirt, grease and other foreign matter. Use the following methods of cleaning:
1. All grease and oil shall be removed in accordance with SSPC- SP 1, "Solvent Cleaning".
2. Following Additional Surface Preparation remove all surface defects likely to be detrimental to the painting system.
3. Prior to initiating painting, all surfaces shall be brushed and vacuum cleaned to remove all dust, shot, grit, etc.

C. Additional Surface Preparation for Specific Finish System: Prepare surfaces according to SSPC specifications as follows:

1. SSPC-SP 2 "Hand Tool Cleaning."
2. SSPC-SP 3 "Power Tool Cleaning."
3. SSPC-SP 5 "White Metal Blast Cleaning."
4. SSPC-SP 6 "Commercial Blast Cleaning."
5. SSPC-SP 7 "Brush-Off Blast Cleaning."
6. SSPC-SP 8 "Pickling."
7. SSPC-SP 10 "Near-White Blast Cleaning."
8. SSPC-SP 11 "Power Tool Cleaning to Bare Metal."

D. Priming: Immediately after surface preparation (within 4 hours and berfore rust bloom occurs), apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

E. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC's "Painting System Guide No. 7.00" to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123.

2.8 SOURCE QUALITY CONTROL

A. Testing and inspection of the structural steel for the Owner's quality assurance will be performed by an independent Testing Agency, retained and paid for by the Owner. The Contractor shall not rely on the Owner's Testing Agency for his quality control.
   1. The Contractor shall furnish to the Testing Agency, as part of the cost of the Work, the following:
      a. A complete set of approved erection drawings and shop drawings.
      b. Cutting lists, order sheets, material bills and shipping bills and schedules.
      c. A complete set of all welding procedures and sequences prepared in accordance with AWS requirements.
      d. Information as to time and place of all rolling and shipment of material to shops.
      e. Representative sample pieces required by the Testing Agency for testing.
      f. Full, safe, and ample means and assistance for testing all material and proper facilities and access, including scaffolding, temporary work platforms, etc. for inspection of the work in the shop and in the field.
      g. Current certificates for all welding operators.
      h. A copy of the fabrication shop's quality control procedures manual.
   2. The Architect and the Testing Agency Inspector shall have the privilege of inspecting the work in the shop or field any time during the period of fabrication or erection. The Architect and the Testing Agency Inspector shall have the privilege to take photographs of the Work for documentation.
   3. The Inspector shall review the material and workmanship of steel, both in the shop and field, for general compliance with the Contract Documents and steel shop drawings. He shall test welded and bolted connections as outlined below. The Inspector shall record types and locations of all defects found in the work and measures required and performed to correct such defects.
      The Contractor shall make all repairs to defective work to the satisfaction of the requirements of the Contract Documents and at no additional cost to the Owner.
   4. The Inspector shall submit reports of his inspection and test findings to the Architect, and the Owner or his representative. He shall record all defects found with subsequent repair operations and submit reports to the Architect.
   5. The work of the Inspector shall in no way relieve the Contractor of his responsibility to comply with all requirements of the Contract Documents, nor shall the work of the Inspector relieve the Contractor's responsibility for quality control of the work either in the shop or in the field.
   6. Testing and Inspection of Welding. The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
      a. All welds shall be visually inspected by the Inspector.
      b. In addition to visual inspection, the welded connections shall be inspected and/or tested by non-destructive testing methods by the Testing Agency as follows:
         1) All welds shall be non-destructively tested at a rate of one in four completed by each welder except as follows:
         2) Every complete penetration weld, such as groove, bevel and butt welds, shall be tested. All partial penetration groove and bevel welds shall be tested. If after 20 tests of any particular type of weld, the failure rate is less than 10%, the testing sample rate may be reduced to every other weld.
         3) Non-destructive test methods shall include the following:

a) Liquid Penetrant Inspection: ASTM E 165.
b) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c) Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T." Use this method where either the Owner or the Testing Agency desires a permanent record of the weld test.
d) Ultrasonic Inspection: ASTM E 164. Use this method for complete penetration and/or groove welds, tee or corner welds.

4) When requested, submit specimens of welded joints and weld metal to the Testing Agency for testing.

7. Testing and Inspection of High Strength Bolts, HSF Bolts (A325 and/or A490). The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
   a. Material: The testing agency shall randomly select bolts for testing at a rate of one per one thousand, and shall test for all requirements of ASTM A325 or A490; including, but not limited to, chemical composition, hardness, dimension, and tensile strength.
   b. Pretension of Bolts in Slip Critical Connections: The testing agency shall review installation of all bolts in Slip-Critical Connections per the requirements of the AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Slip-Critical Connections will be specifically identified on the Drawings.
   c. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.
   d.
8. Testing and Inspection of Welded Studs. The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
   a. Pre-production Testing: The testing agency shall review the Contractor's pre-production testing. The Contractor shall perform this testing at his expense per AWS D1.1 Section 7.7.
   b. The testing agency shall conduct testing per AWS D1.1 Section 7.8.
   c. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
   d. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

2.9 BASE PLATES AND ANCHOR BOLTS:

A. Base plates supported on concrete, whether shop attached or shipped loose, shall be furnished with and set upon leveling nuts and/or shims or leveling plates. Base plates shall have holes for bleeding off air during grouting. Grout shall be per Section 2.5, and shall be provided and placed by the Steel Contractor.

B. Templates shall be furnished by the Contractor for all Anchor Bolts to be used to set the bolts. Templates shall be fabricated from steel plate, minimum thickness 1/8” (3 mm). The Contractor is to check carefully the setting of the bolts to the proper position prior to placement of concrete. Anchor bolts shall have nuts and washers. Damaged threads shall be repaired or re-cut to permit full tightening of nuts. The above applies to all anchor bolts.

2.10 OTHER MATERIALS:

All other materials, not specifically described but required for a complete and proper installation of structural steel, shall be provided and shall be new, free from rust, first quality of their respective kinds, and subject to the acceptance by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Surveys: Employ a registered professional engineer or land surveyor for the steel erection, to assure accurate erection of all structural steel. Survey elevations & locations of all bearing surfaces, anchor bolts and similar devices before erection proceeds.

B. Notify the General Contractor in writing of conditions detrimental to proper and timely completion of work.

C. Do not proceed with erection until unsatisfactory conditions have been corrected in manner acceptable to the Steel Erector and the Architect.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Temporary bracing shall be left in place as long as may be required for safety. The bracing shall be located so it does not interfere with the erection and installation of the metal deck, and can be removed as required during construction. Coordinate with other sub-contractors so as to minimize interference with the general progress of their work. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

B. The structure is designed to be self-supporting and stable after the building is fully completed. It is the Contractor's sole responsibility to determine erection procedures, sequencing and temporary bracing; to determine the adequacy and strength of any parts of the structure being used as temporary supports or tie-downs; and to ensure the safety of the building and its component parts during erection, except as specifically directed in writing by the Architect, the Engineer, or the Owner. This includes the addition of whatever temporary bracing, guys, shoring, or tie-downs that might be necessary. Such materials shall be removed by the Contractor and remain his property after completion of the project.

3.3 ERECTION

A. The steel erector shall employ a competent superintendent to supervise all work of erection. This superintendent shall be present at all times during this phase of the work.

B. Coordinate erection activities with the other contractors to minimize impact on other work on site. Allow access to the steel work by other trades.

C. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

D. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

a. Comply with manufacturer's instructions for proprietary grout materials.

E. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

F. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service.

G. Splice members only where indicated.

H. Remove erection bolts on welded, architecturally exposed structural steel; and grind smooth at exposed surfaces. Do not fill holes with plug welds. Install bolts snug tight to fill holes when approved by Architect.

I. Do not use thermal cutting during erection.

J. Finish sections thermally cut during erection equal to a sheared appearance.

K. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Field install and tighten non-high-strength.

B. Field install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325, Assume high strength bolts are to be used except where non-high-strength bolts are indicated.

1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
3. Recommended procedure for installing assembling bolt groups:
   a. Assemble joint using drifts to obtain correct alignment.
   b. Fit bolts. Use hardened washers under the turned part. Lubricate bolts to prevent nuts seizing on the bolts. Lubricate with a liquid high pressure lubricant and apply only to the outstanding threads after the bolts have been inserted through the steel work, taking care to prevent lubricant getting between the plies of the joint.
   c. Tighten bolts sufficiently in an appropriate sequence to bring joint surfaces into uniformly close contact.
   d. Where indicated pretension bolts to the appropriate levels using load indicator washers, turn-of-the-nut, or other suitable means. If turn of the nut method of pretensioning bolts is used, demonstrate to the satisfaction of the Testing Agency that the desired bolt tensions are achieved for the various combinations of bolt sizes, lengths and connection plies.
   e. Mark each bolted connection when all bolts in the connection are pre-tensioned. Do not touch-up paint until bolts have been inspected by the Testing Agency. The Testing Agency will mark connections which have been inspected.

C. Weld Connections: Only make field welded connections where previously approved by the Engineer of Record. When field welds are approved or specified by the Engineer of record, comply with all requirements of section 2.5D of this specification.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch (13 mm) and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

A. Testing and inspection of the structural steel for the Owner's quality assurance will be performed by an independent Testing Agency, retained and paid for by the Owner. The Contractor shall not rely on the Owner's Testing Agency for his quality control.
1. The Contractor shall furnish to the Testing Agency, as part of the cost of the Work, the following:
   a. A complete set of approved erection drawings and shop drawings.
   b. Cutting lists, order sheets, material bills and shipping bills and schedules.
   c. A complete set of all welding procedures and sequences prepared in accordance with AWS requirements.
   d. Information as to time and place of all rolling and shipment of material to shops.
   e. Representative sample pieces required by the Testing Agency for testing.

f. Full, safe, and ample means and assistance for testing all material and proper facilities and access, including scaffolding, temporary work platforms, etc. for inspection of the work in the shop and in the field.
g. Current certificates for all welding operators.
h. A copy of the fabrication shop's quality control procedures manual.

2. The Architect and the Testing Agency Inspector shall have the privilege of inspecting the work in the shop or field any time during the period of fabrication or erection. The Architect and the Testing Agency Inspector shall have the privilege to take photographs of the Work for documentation.
3. The Inspector shall review the material and workmanship of steel, both in the shop and field, for general compliance with the Contract Documents and steel shop drawings. He shall test welded and bolted connections as outlined below. The Inspector shall record types and locations of all defects found in the work and measures required and performed to correct such defects.
   The Contractor shall make all repairs to defective work to the satisfaction of the requirements of the Contract Documents and at no additional cost to the Owner.
4. The Inspector shall submit reports of his inspection and test findings to the Architect, and the Owner or his representative. He shall record all defects found with subsequent repair operations and submit reports to the Architect.
5. The work of the Inspector shall in no way relieve the Contractor of his responsibility to comply with all requirements of the Contract Documents, nor shall the work of the Inspector relieve the Contractor's responsibility for quality control of the work either in the shop or in the field.
6. Testing and Inspection of Welding. The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
   a. All welds shall be visually inspected by the Inspector.
   b. In addition to visual inspection, the welded connections shall be inspected and/or tested by non-destructive testing methods by the Testing Agency as follows:
      1) All welds shall be non-destructively tested at a rate of one in four completed by each welder except as follows:
      2) Every complete penetration weld, such as groove, bevel and butt welds, shall be tested. All partial penetration groove and bevel welds shall be tested. If after 20 tests of any particular type of weld, the failure rate is less than 10%, the testing sample rate may be reduced to every other weld.
      3) Non-destructive test methods shall include the following:
         a) Liquid Penetrant Inspection: ASTM E 165.
         b) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
         c) Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T." Use this method where either the Owner or the Testing Agency desires a permanent record of the weld test.
         d) Ultrasonic Inspection: ASTM E 164. Use this method for complete penetration and/or groove welds, tee or corner welds.
      4) When requested, submit specimens of welded joints and weld metal to the Testing Agency for testing.
7. Testing and Inspection of High Strength Bolts, HSF Bolts (A325 and/or A490). The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :
   a. Material: The testing agency shall randomly select bolts for testing at a rate of one per one thousand, and shall test for all requirements of ASTM A325 or A490;

including, but not limited to, chemical composition, hardness, dimension, and tensile strength.

b. Pretension of Bolts in Slip Critical Connections: The testing agency shall review installation of all bolts in Slip-Critical Connections per the requirements of the AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts. Slip-Critical Connections will be specifically identified on the Drawings.

c. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

d.

8. Testing and Inspection of Welded Studs. The Contractor shall assume, but the Owner shall not be obligated to provide, the following scope of testing and inspection :

a. Pre-production Testing: The testing agency shall review the Contractor's pre-production testing. The Contractor shall perform this testing at his expense per AWS D1.1 Section 7.7.

b. The testing agency shall conduct testing per AWS D1.1 Section 7.8.

c. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.

d. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to requirements of AWS D1.1.

3.6 CLEANING

A. Touchup Painting: All requirements of shop painting shall apply to field touch up painting.

Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

2. HSF Bolted connections : Do not paint HSF bolted connections until they have been reviewed by the Testing Agency Inspector. Once bolted connections have been reviewed by the Inspector clean and apply protective coatings to the exposed surfaces including the surrounding edges to same standard as the balance of the steel work. Fill gap of load indicator washers with protective treatment.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on structural steel are included in Division 9 Section "Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint according to ASTM A 780.

END OF SECTION 051200

SECTION 053100 - STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. In the event of conflict between any of the provisions of these documents, including the Drawings and this section of the specification, the requirements of the more stringent shall govern.

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Roof deck.

B. Responsibilities of the Contractor:
1. The Contractor shall detail the metal deck and accessories.
2. The manufacturer shall review the use, details and method of installation of this product as indicated and shall disclose to the Architect any and all deviations from his recommended use and method of installation and shall also disclose to the Architect his recommendations for the use and method of installation of his product to achieve the intended purpose and result. Such disclosures shall be made within the time stipulated for the submission of shop drawings.
3. The Contractor shall supply of all roof decks.
4. The Contractor shall supply of all fasteners and accessory items required to make a complete and serviceable installation.

C. Related Sections include the following:
1. Division 5 Section "Structural Steel".
2. Division 5 Section "Cold Formed Metal Framing"
3. Division 7 Section Roofing and insulation.

1.3 PERFORMANCE REQUIREMENTS
1. Metal deck is intended to serve functions other than to resist directly applied loads.
2. The roof metal deck, **VULCRAFT 1.5" 20 GA TYPE B ROOF**, is required to brace the framing supporting the deck. These functions require that the roof deck be fastened at regular intervals to all supporting steel and that the roof deck act as a shear diaphragm.
3. The roof metal deck is required to act as a shear diaphragm. This diaphragm is employed to resist lateral wind loads on the perimeter walls and is part of the lateral load resisting system of structure. In addition the deck is needed to brace the compression flanges of supporting steel flexural members, and miscellaneous framing supporting the deck. These functions require that the roof deck be fastened at regular intervals to all supporting steel.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of decking, all fasteners and all accessories

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.

C. Color and Finish Samples: Submit color and finish samples of painted and prefinished deck for the Architect's review and acceptance.

D. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.

E. Welding Certificates: Copies of certificates for welding procedures and personnel.

F. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:

1. Mechanical fasteners.

G. Research/Evaluation Reports: Evidence of steel deck's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise indicated or specified; latest editions of each standard will apply, unless specifically identified otherwise:
1. New York State Building Code
2. American Institute of Steel Construction (AISC):
   a. "Code of Standard Practice for Steel Buildings and Bridges", and Supplements Nos. 1, 2, 3 and 5, except as modified by provisions noted herein.
   b. "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
3. AISI "Specification for the Design of Cold-Formed Steel Structural Members".
4. AWS D1.3 "Structural Welding Code - Sheet Steel".
5. Steel Deck Institute, SDI, "Design Manual for Floor Decks and Roof Decks".
6. Steel Deck Institute, SDI, "Diaphragm Design Manual"- Second Edition.
7. American Society for Testing and Materials (ASTM) - as referenced herein.

In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these Specifications, the provisions of the more stringent shall govern.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

D. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

E. FM Listing: Provide steel roof deck evaluated by FM and listed in FM's "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.7 COORDINATION

A. Coordinate layout of openings with MEP drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Deck:

a. BHP Steel Building Products USA Inc.
b. Consolidated Systems, Inc.
c. Epic Metals Corp.
d. Marlyn Steel Products, Inc.
e. Nucor Corp.; Vulcraft Div.
f. Roof Deck, Inc.
g. United Steel Deck, Inc.
h. Verco Manufacturing Co.
i. Wheeling Corrugating Co.; Div. of Wheeling-Pittsburgh Steel Corp.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 29, and the following unless indicated otherwise on the Contract Drawings/Details:
1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G90 zinc coating.

2. Deck Profile: Type B wide rib
3. Profile Depth: 1-1/2”
4. Design Uncoated-Steel Thickness: 0.0358 inch (20 gauge)
5. Minimum Deck section properties are S=0.318> cu.in. and I=0.212> in^4.
6. Span Condition: As indicated on drawings.
7. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. DECK FASTENERS:
1. Deck fasteners shall be subject to compliance with all requirements of the Drawings and specifications, manufacturers
2. Metal Deck Fasteners: All deck shall be fastened to the supporting steel by either welds, screws, or powder or air actuated pin fasteners. All fasteners must be recognized by the Steel Deck Institute and the ICBO Evaluation Service Inc, the SBCCI, or the Council of American Building Officials.
3. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
   a. All Air or Powder Actuated Pin Fasteners must be recognized by the Steel Deck Institute and either the ICBO Evaluation Service Inc, the SBCCI, or the Council of American Building Officials.
   b. The following manufacturers supply products which generally comply with these requirements:
      1) PNEUTEK ®, Inc., 29 Flagstone Drive, Hudson, NH, 03051.
      2) HILTI®, Corporation, PO Box 21148, Tulsa, OK, 74121.
4. Frame Fasteners: are fasteners between deck units and all supporting structural elements. Welds, power/pneumatic pins, and screws are acceptable Frame fasteners.
5. Side-Lap Fasteners: shall be corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8 mm) minimum diameter or welds.

C. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

F. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, [0.0598 inch (1.52 mm)] [0.0747 inch (1.90 mm)] thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

G. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and recessed pans of 1-1/2- inch (38-mm) minimum depth. For drains, cut holes in the field.

H. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

I. Galvanizing Repair Paint: DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

J. Repair Paint: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

2.4 FABRICATION:

A. General: Form deck units in lengths for 3 spans on 4 or more supports where ever possible. Provide for flush, telescoped or nested 2" laps at ends and interlocking or nested side laps, unless otherwise indicated.

B. Roof Deck Units: Provide deck configurations complying with SDI "Roof Deck Specifications", of metal thickness, depth and width as shown on the Drawings.

C. Roof Sump Pans: Fabricate from single piece of 0.071" min. (14 gage) galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain, unless otherwise shown. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3" wide. Recess pans not less than 1-1/2" below roof deck surface, unless otherwise shown or required by deck configuration. Holes for drains will be cut in the field.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer must examine areas and conditions under which metal decking is to be installed and notify the General Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION, GENERAL

A. Coordinate the deck installation and fastening with the sequencing of the structural steel erection. The deck may be required to brace the steel work during its erection. Ensure that the deck and its fastenings can be subjected to distortions during the deck and/or structural steel installation without permanent deformation or damage.

B. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.

C. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

D. Locate decking bundles to prevent overloading of supporting members.

E. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

F. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

G. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

H. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

I. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

J. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to the more stringent of the deck manufacturer's written instructions and/or Contract requirements .

3.3 ROOF DECK INSTALLATION

A. Uplift Loading on Roof Deck: In combination with any diaphragm and gravity loads, Install and anchor roof deck units to resist uplift loading of 40 lbs. per sq. ft. No increase in allowable fastener loads is allowed for wind

B. Frame Fastening: Fasten roof deck panels to steel supporting members by screws as indicated on the design drawings.

C. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18”, and as follows:

1. Mechanically fasten with self-drilling No. 10 (4.8-mm-) diameter or larger carbon-steel screws.
2. Mechanically clinch or button punch except for roof decks utilized as diaphragms. Assume all roof decks act as diaphragms unless noted otherwise.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum or butted at Contractor's option.

E. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least 1 weld at each corner.

F. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

G. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.

B. Field welds will be subject to inspection.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Floor joist framing.
4. Roof rafter framing.
5. Ceiling joist framing.
6. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Coordinate with architect.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

3. For cold-formed metal framing indicated to comply with design loads, include structural analysis and detailed shop drawings signed and sealed by a qualified professional engineer, who shall be licensed in the State in which the Project is located and responsible for their preparation.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research/Evaluation Reports: For cold-formed steel framing.

1. Metal stud manufacturer to have a third party evaluation report for its products that are reviewed to the local building code or its model code (IBC 2009 and AISI S100 or IBC 2012 and AISI S100)

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member in good standing of the Steel Framing Industry Association (SFIA).

1. Products to be certified under an independent third party inspection program administered by an agency accredited by IAS to ICC-ES AC98 IAS Accreditation Criteria for Inspection Agencies.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this project in material, design, and extent.

D. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

E. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-steel thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

F. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

G. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by, and displaying a classification label from, a testing and inspecting agency acceptable to authorities having jurisdiction.

H. Comply with AISI Specifications and Standards.

1. AISI S100 “North American Specification for the Design of Cold-Formed Steel Structural Members”.
2. AISI S200 “North American Standard for Cold-Formed Steel Framing – General Provisions”.
3. AISI S201 “North American Standard for Cold-Formed Steel Framing – Product Standard”.
4. AISI S211 “North American Standard for Cold-Formed Steel Framing – Wall Stud Design”.
5. AISI S212 “North American Standard for Cold-Formed Steel Framing – Header Design”.
6. AISI S213 “North American Standard for Cold-Formed Steel Framing – Lateral Design”.
7. AISI “Code of Standard Practice for Cold-Formed Steel Structural Framing”.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI's "Code of Standard Practice".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide cold-formed metal framing products manufactured by ClarkDietrich Building Systems or equivalent.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: See General Notes and Load Key plan drawings.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height.
b. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
c. Floor Joist Framing: Vertical deflection of 1/360 for live loads and l/240 for total loads of the span.
d. Roof Rafter Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

a. Upward and downward movement of 1/2 inch

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: 50
2. Coating: G90 (Z275)

B. Steel Sheet for Clips: ASTM A 1003/A 1003M, ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50
2. Coating: G90 (Z275).

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Basis-of-Design Product: ClarkDietrich Building Systems.
2. Minimum Base-Steel Thickness: As indicated on drawings
3. Flange Width: As indicated on drawings
4. Section Properties: As indicated on drawings

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Steel Thickness: As indicated on drawings
2. Flange Width: As indicated on drawings.

C. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges and as follows:

1. Basis-of-Design Product: As indicated on drawings

D. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as indicated on the drawings.

E. Opening Framing:

1. Basis-of-Design Product: ClarkDietrich Building Systems; RedHeader RO System.
2. Allow for alternative valued engineered opening framing systems (RedHeader RO System) manufactured by ClarkDietrich Building Systems.
3. Minimum Base-Steel Thickness: As required by design.
4. Minimum Flange Width: As required by design.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Basis-of-Design Product: ClarkDietrich Building Systems.
2. Minimum Base-Steel Thickness: As indicated on drawings
3. Flange Width: As indicated on drawings
4. Section Properties: As indicated on drawings

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Steel Thickness: As indicated on drawings
2. Flange Width: As indicated on drawings

C. Headers and Jambs - Heavy-Duty Stud: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges and as follows:
1. Basis-of-Design Product: Minimum Base-Steel Thickness: As indicated on drawings

D. Bridging and Spacer Bar:

1. Basis-of-Design Product: ClarkDietrich Building Systems; TradeReady Spazzer 5400
2. Minimum Base-Steel Thickness: 0.0538 inch (1.37 mm).
3. Size: 1-1/4 by 1-1/4 by 50 inches (32 by 32 by 1270 mm) long, pre-notched at 12, 16 and 24 inches (305, 406, and 610 mm) centers.

2.6 FLOOR JOIST FRAMING

A. Steel Floor Joists: Manufacturer's proprietary cold-formed galvanized steel joists, of web depths indicated, featuring large extruded holes and as follows:

1. Basis-of-Design Product: ClarkDietrich Building Systems; TradeReady Steel Joists.
2. Minimum Base-Steel Thickness: as indicated on drawings

B. Steel Joist Rim Track: Manufacturer’s standard U-shaped steel joist track; punched with clip angles at required joist spacing, of web depths indicated; with stiffened webs and as follows:
1. Minimum Base-Steel Thickness: as indicated on drawings

C. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched with stiffened flanges, and as follows:

1. Basis-of-Design Product: ClarkDietrich Building Systems.
1. Minimum Base-Steel Thickness: as indicated on drawings

D. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Steel Thickness: as indicated on drawings

2.7 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Basis-of-Design Product: ClarkDietrich Building Systems.
1. Minimum Base-Steel Thickness: as indicated on drawings

B. Built-up Members: Built-up members of manufacturer's standard C-shaped steel section, with stiffened flanges, nested into a U-shaped steel section joist track, with unstiffened flanges; punched with large service holes of web depths indicated; and as follows:
1. Minimum Base-Steel Thickness: as indicated on drawings

2.8 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.

a. Basis-of-Design Product: ClarkDietrich Building Systems; [Spazzer 5400 Bridging Bar (SPZS)

3. Web stiffeners.

a. Basis-of-Design Product: ClarkDietrich Building Systems; QTWS.

4. Anchor clips.

5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.9 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C

C. Retain "Expansion Anchors" Paragraph below if expansion anchors are acceptable. Verify safety factor with Project's structural engineer. Revise as required or insert specific load requirements and names of acceptable products.

D. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

G. Welding Electrodes: Comply with AWS standards.

2.10 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 ASTM A 780

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.11 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Install cold-formed framing in accordance with ASTM C1007 and AISI S200 "North American Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

B. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: as indicated on drawings

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch (3 mm) between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: as indicated on drawings

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of indicated on drawings or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads. A single

proprietary jamb member designed specifically for the purpose of supporting the header may be used in lieu of multiple members.

2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.

1. Bridging: Steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (152.4 mm) deep.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure as shown in shop drawings.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: as indicated on drawings

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Bridging: Steel channel, welded or mechanically fastened to webs of punched studs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

E. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

A. Install in accordance with AISI's S210 "North American Standard for Cold-Formed Steel Framing - Floor and Roof System Design".

B. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

C. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

D. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:

1. Joist Spacing: As indicated on drawings

E. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

F. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated **on** Shop Drawings.

1. Install web stiffeners to transfer axial loads of walls above.

G. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

H. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

I. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following as required to complete the project work:

1. Miscellaneous framing and supports (except where otherwise included in other Division 05 sections)
2. Miscellaneous metal trim (except where otherwise included in other Division 05 sections)
3. Loose steel lintels (except where otherwise included in other Division 05 sections)

B. Products furnished, but not installed, under this Section:

C. Related Sections:

1. Division 03 - Concrete
2. Division 04 - Masonry
3. Division 05 - Metals

1.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Manufacturer's Product Data: Submit manufacturer's specifications, load tables, details and installation instructions for items specified, including but not limited to paint products and grout.

B. Shop Drawings: Submit shop drawings detailing fabrication and erection of each metal fabrication indicated; coordinated with shop drawings submitted by related trades. Include dimensioned plans, elevations, sections, and large scale details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

C. Templates: For anchors and bolts.

D. Samples: Submit samples representative of materials and finished products as may be requested by Architect.

E. Certificates: Submit welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

F. Qualification Data: Submit data qualifying firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of architects and owners, and other information specified.

G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.

C. Steel Tubing: ASTM A 500, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

E. Slotted Channel Framing: Cold-formed metal channels complying with MFMA-3, 1-5/8 by 1-5/8 inches. Channels made from galvanized steel complying with ASTM A 653, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.

F. Cast Iron: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

G. Post-Installed Anchors: Torque-controlled expansion anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
1. Products:

a. Carboline Company; Carbozinc 621.
b. ICI Devoe Coatings; Catha-Coat 313.
c. Tnemec Company, Inc.; Tneme-Zinc 90-97.

D. Galvanizing Repair Paint: SSPC-Paint 20, high-zinc-dust-content paint for regalvanizing welds in steel.

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Steel Tube Supports for Countertops: Utilize steel tube supports sized to support dead loads of countertops, and in addition a uniform live load of 300 psf. Where exposed in the finish work, provide welded connections, ground smooth and primed for field painting specified in Division 09, Section, "Painting". Where concealed, utilize bolts and connectors of capacity required to support imposed live and dead loads. Anchor steel tubes to structural walls and slabs as required for a secure and rigid installations. Fasten tubes to countertops with fasteners applied through the tubes into the underside of tops, and in sufficient quantity for a secure installation.

D. Steel Frames for Rolling Doors: Provide shop prime painted steel door frames for rolling doors fabricated from structural shapes in accordance with the requirements of the door manufacturer. Plug weld built-up members and continuously weld exposed joints. For securing door frames into adjacent masonry or concrete, provide steel strap anchors 1/8 in. thick x 2 in. wide length required for a minimum 8 in. embedment, unless otherwise shown. Weld anchors to frame jambs not more than 12 in. from both bottom and head of frame and space anchors not more than 30 in. apart. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames. Reinforce, drill, tap and prepare as required to receive finish hardware.

E. Galvanize miscellaneous framing and supports where indicated.

F. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.9 ABRASIVE METAL NOSINGS, TREADS, AND THRESHOLDS

A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Safety Tread Co., Inc.
b. Balco Inc.
c. Safe-T-Metal Company, Inc.
d. Wooster Products Inc.

2. Nosings: Cross-hatched units, 1-1/2 by 1-1/2 inches, for casting into concrete curbs.
3. Treads: Cross-hatched units, full depth of tread with 3/4-by-3/4-inch nosing, for application over bent plate treads or existing stairs.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

1. Provide two rows of holes for units more than 5 inches wide, with two holes aligned at ends and intermediate holes staggered.

D. Apply bituminous paint to concealed surfaces of cast-metal units.

2.10 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.11 MANHOLE COVERS

A. Manhole Cover and Frame: Provide hot dipped galvanized steel manhole cover and frame in locations as shown, consisting of 4 in. x 3 in. x 1/4 in. thick steel angle continuously welded to a 1 in. x 1/2 in. steel bar with anchors welded to backs of angles at 2 ft. centers with a minimum of eight (8) anchors per unit, and cast iron pit cover fabricated to be secured to support frame.

B. Man holes and covers for access to underground utilities.

2.12 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

A. Hot-dip galvanize items as indicated to comply with ASTM A 123 or ASTM A 153 as applicable.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below for environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

C. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 07 Section "Sealants" to provide a watertight installation.

3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055210 – ALUMINUM RAILINGS

PART 1 - GENERAL

1.01 SUMMARY

A. WORK INCLUDED
1. Furnish and install aluminum railings and components.
B. WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS
1. Furnish anchors into steel beams per structural drawings
C. RELATED WORK
1. Section 061000 - Rough Carpentry
D. Shop drawings to be signed and sealed by a NYS licensed structural engineer.

1.02 REFERENCES

A. Aluminum Association (AA)
1. ABH-21: Aluminum Brazing Handbook
2. ASD-1: Aluminum Standards and Data
3. DAF-45 Designation System for Aluminum Finishes
4. SAA-46 Standards for Anodized Architectural Aluminum

B. American Architectural Manufacturers Association (AAMA)
1. AAMA 605.1 Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
2. AAMA 606.1 Voluntary Guide Specifications and Inspection Methods of Integral Color Anodic Finishes for Architectural Aluminum.
3. AAMA 607.1 Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
4. AAMA 608.1 Voluntary Guide Specifications and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

C. American National Standards Institute (ANSI)
1. A21.1 Safety Requirements for Floor and Wall Openings, Railings and Toe Boards.
2. A58.1 Minimum Design Loads in Buildings and Other Structures.
3. A117.1 Accessible and Usable Buildings and Facilities.

D. American Society for Testing and Materials (ASTM)
1. B 26 Specification for Aluminum-Alloy Sand Castings.
2. B 221 Specification for Aluminum-Alloy Bars, Rods, Wires, Shapes and Tubes.
3. B 429 Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
4. B 483 Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications.
5. E 894 Standard Test Methods for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
6. E 935 Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
7. E 985 Specification for Permanent Metal Railing Systems and Rails for Buildings.

E. National Association of Architectural Metal Manufacturers (NAAMM)
1. Metal Finishes Manual
2. Pipe Railing Manual
3. Stair Manual

F. National Fire Protection Association (NFPA)
1. 101 Life Safety Code

G. National Ornamental and Miscellaneous Metals Association (NOMMA)
1. Metal Rail Manual

1.03 SYSTEM DESCRIPTION

Check governing codes for requirements.

A. Structural Requirements
1. Guardrail assemblies and attachments shall withstand a minimum concentrated load of at least 200 pounds applied in any downward or outward direction within 2 inches (5 cm) of any point along the top edge of the rail.

1.04 SUBMITTALS

A. Product Data
1. Submit manufacturers engineering data and installation instructions under provisions of Section [01300] [01340].

B. Shop Drawings
1. Submit shop drawings and product data under provisions of Section [01300] [01340].
2. Indicate component details, materials, finishes, connection and joining methods, and the relationship to adjoining work.

C. Samples
1. Furnish 12” sample of railing and accessories in selected finish

1.05 QUALITY ASSURANCE

A. QUALIFICATIONS
1. Furnish references listing projects of similar size and scope.

B. REGULATORY REQUIREMENTS
1. Components and installation are to be in compliance with state and local code authorities.
2. Components and installation are to follow current ADA and CABO/ANSI guidelines.

C. CERTIFICATIONS
1. Furnish certification that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.
2. Furnish certification that components were installed in accordance to manufacturers engineering data to meets the specified design loads.

D. PRE-INSTALLATION MEETING
1. Prior to the beginning of work, conduct a pre-job conference at the job site.
2. Provide seven calendar days advance written notice ensuring the attendance by competent authorized representatives of the fabricator, building owners representative, architect, and subcontractors whose work interfaces with the work of this Section.
3. Review the specifications to determine any potential problems, changes, scheduling, unique job site conditions, installation requirements and procedures and any other information pertinent to the installation.
4. Record the results of the conference and furnish copies to all participants.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

B. Storage on site:
1. Store material in a location and in a manner to avoid damage. Stack in a way to prevent bending.
2. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.

C. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Railing and components shall be as manufactured and distributed by JULIUS BLUM & CO., INC., of Carlstadt, New Jersey (800) 526-6293, for its CONNECTORAIL® System.

2.02 MATERIALS AND FINISHES

A. Aluminum:
1. Extruded Pipe: Alloy 6063-T52 meeting ASTM B 221
2. Drawn Pipe: Alloy 6063-T832 meeting ASTM B 483
3. Reinforcing Bars: Alloy 6061-T6 meeting ASTM B 221
4. Extruded Bars, Shapes, and Mouldings : Alloy 6063-T52 meeting ASTM B 221
5. Extruded Posts: Alloy 6063-T6 meeting ASTM B 221
6. Castings: Almag 35 meeting ASTM B 26
7. Extruded Toe Board: Alloy 6063-T52 meeting ASTM B 221 and the safety requirements of ANSI A21.1
8. Finish (refer to NAAMM Metal Finishes Manual):
    a. Clear anodized aluminum

2.03 RAILING SYSTEM

A. Material shall conform to 2.02. and be finished in accordance with 2.02.
B. Railing system shall be permanently anchored].
C. Rails [and Posts]
1. Fabricate rails and posts from anodized aluminum, 6063-T52 with nominal size of 1.5 inches Provide post reinforcement in finish to match railing system.
D. Posts
1. Fabricate posts from anodized aluminum 6063-T832 pipe with a nominal size of 2.0 inches. Provide post reinforcement in finish to match railing system.
E. Fittings
1. Fittings shall be of wrought aluminum. Tee-fittings and elbows that are fabricated from more than one piece shall be of welded construction with no weld marks visible when the fitting is installed.
F. Connector Sleeves
1. Internal connector sleeves shall be of extruded aluminum.
G. Mounting Flanges
1. Flanges shall be heavy-duty floor flange shall be of cast aluminum with a solid aluminum reinforcing bar.
3. Facia flanges shall be of aluminum with a solid aluminum reinforcing bar.
H. Toe Board
1. Toe Board shall be of extruded aluminum; BLUM No. 6446.

2.04 FASTENERS

A. Mechanical Fasteners:
1. CONNECTORAIL®
    a. RHMS 1/4”-20 x 1” SEMS with lock washer, stainless steel.
    b. 1/4”-20 x [21/2”] [3”] RHMS with lock nut, stainless steel.
    c. [A25-140] [A25-200] internally threaded tubular rivets, aluminum.
    d. 3/8” x 3” sleeve anchor bolt, cadmium-plated steel.
    e. Machine screws used to mount facia flanges to stringers shall be of [stainless] [galvanized] [cadmium-plated] steel, 3/8-inch diameter.

2.05 HANDRAIL BRACKETS

A. Aluminum

2.06 FABRICATION

A. Form [rail-to-end post connections and] all changes in rail direction by [miter] [radius] elbows.
B. Cut material square and remove burrs from all exposed edges, with no chamfer.
C. Make exposed joints tight and flush.
D. Close exposed ends of [pipe] [handrail] with appropriate end cap.
E. For posts set in concrete, furnish matching sleeves or inserts not less than 5 inches long.
F. Locate intermediate rails as shown on the elevations.
G. Verify dimensions on site prior to shop fabrication.

PART 3 - EXECUTION

3.01 PREPARATION

A. Supply items to be [cast in concrete] [embedded in masonry] [placed in partitions].
B. Verify anchor installation and other site conditions are acceptable.

3.02 DISSIMILAR METALS

A. Paint bronze, nickel-silver, and aluminum components that come into contact with dissimilar metals with [a heavy coat of a proper primer] [asphalt paint].
B. Paint exposed aluminum components that come into contact with cement or lime mortar, with [heavy-bodied bituminous paint] [water-white methacrylate lacquer] [zinc chromate].

3.03 INSTALLATION

A. Install in accordance with shop drawings [and manufacturers instructions].
B. Erect work [square and level,] [horizontal or parallel to rake of steps or ramp,] [and] free from distortion or defects detrimental to appearance or performance.
C. Provide expansion joints as needed to allow for thermal expansion or contraction.

3.04 CLEANING

A. As installation is completed, wash thoroughly using clean water and soap; rinse with clean water.
B. Do not use acid solution, steel wool, or other harsh abrasives.
C. If stain remains after washing, remove finish and restore in accordance with NAAMM Metal Finishes Manual.
D. Finish must not be removed from anodized aluminum. Return component to anodizer for re-anodizing.

3.05 REPAIR OF DEFECTIVE WORK

A. Remove stained or otherwise defective work and replace with material that meets specification requirements.

END THIS SECTION

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Rooftop equipment bases and support curbs
2. Wood blocking, cants, and nailers.
3. Utility shelving.
4. Plywood panels.
5. Plywood flooring in mechanical penthouse (fire-rated marine plywood)

B. Related Sections include the following:

1. Division 06, Section "Interior Architectural Woodwork".

C. All woodwork used on this project to be "Fire Retardant Treated Wood".

1.3 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.
7. Metal framing anchors.

1.5 QUALITY ASSURANCE

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, blocking and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Provide fire-retardant treatment for all lumber and plywood supplied as work of this section. Pressure impregnate lumber and plywood with fire retardant chemicals to comply with AWPA C20 and C27, respectively, for treatment type indicated and identify "fire retardant treated wood" with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Framing for non-load-bearing partitions.
3. Framing for non-load-bearing exterior walls.
4. Roof construction.
5. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Utility shelving.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For exposed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Hem-fir or hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
2. Eastern softwoods, No. 2 Common grade; NeLMA.
3. Northern species, No. 2 Common grade; NLGA.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A307, Grade A; with ASTM A563 hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 PLYWOOD FLOORING IN MECHANICAL PENTHOUSE

A. Use fire-rated marine plywood

2.8 MISCELLANEOUS MATERIALS

H. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

G. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required forattaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061643 GYPSUM SHEATHING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Fiberglass-mat faced, moisture and mold resistant gypsum sheathing.

B. Related Sections:
1. Section 05 41 00 Structural Metal Stud Framing.
2. Section 06 10 00 Rough Carpentry.
3. Section 09 21 16 Gypsum Board Assemblies.

1.02 REFERENCES

A. ASTM International (ASTM):
1. ASTM C473 Standard Test Methods for Physical Testing of Gypsum Panel Products.
2. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
3. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
4. ASTM C1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
5. ASTM C1280 Standard Specification for Application of Gypsum Sheathing.
6. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
7. ASTM D6329 Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers.
8. ASTM E72 Standard Test Methods of Conducting Strength Tests of Panels for Build-ing Construction.
9. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.

B. Gypsum Association (GA): GA-253 Application of Gypsum Sheathing.

1.03 SUBMITTALS

A. Product Data: Manufacturer’s specifications and installation instructions for each product specified.

1.04 WARRANTY

A. Provide products that offer twelve months of coverage against in-place exposure damage (delamination, deterioration and decay) commencing with the date of in-stallation of the product in such structure.
B. Manufacturer’s Warranty:
1. Five years against manufacturing defects from the date of purchase of the product for installation

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Georgia-Pacific Gypsum LLC:
1. Fiberglass-Mat Faced Gypsum Sheathing, Type X for Fire Rated Designs: DensGlass Fireguard Sheathing.

2.02 MATERIALS
A. Fire-Rated Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177, Type X:
1. Thickness: 5/8 inch.
2. Width: 4 feet.

3. Length: [8 feet] [9 feet] [10 feet].
4. Weight: 2.5 lb/sq. ft.
5. Edges: Square.
6. Surfacing: Fiberglass mat on face, back, and long edges.
7. Racking Strength (Ultimate, not design value) (ASTM E72): Not less than 654 pounds per square foot, dry.
8. Flexural Strength, Parallel (ASTM C1177): 100 lbf, parallel.
9. Humidified Deflection (ASTM C1177): Not more than 1/8 inch.
10. Permeance (ASTM E96): Not less than 17 perms.
11. R-Value (ASTM C518): 0.67.
12. Mold Resistance (ASTM D3273): 10, in a test as manufactured.
13. Microbial Resistance (ASTM D6329, UL Environmental GREENGUARD 3-week proto-col): Will not support microbial growth.
14. Acceptable Products:

a. 5/8 inch DensGlass Fireguard Sheathing, Georgia-Pacific Gypsum LLC. b.

2.03 ACCESSORIES

A. Screws: ASTM C1002, corrosion resistant treated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:

1. Inspection: Verify that project conditions and substrates are acceptable, to the install-er, to begin installation of work of this section.

3.02 INSTALLATION

A. General: In accordance with GA-253, ASTM C1280 and the manufacturer’s recommendations.

3.03 PROTECTION

A. Protect gypsum board installations from damage and deterioration until date of Substantial Completion.

END OF SECTION 061643

064020 - ARCHITECTURAL WOODWORK

1. RELATED DOCUMENTS

   A. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2. DESCRIPTION OF WORK:

   A. All architectural woodwork items including all Division 06 construction key notes on Architectural drawings.
   B. Include in this section work Solid Polymer Countertop

3. RELATED WORK SPECIFIED ELSEWHERE:

   A. Division 15 – Plumbing (not used)

4. SUBMITTALS:

   A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

   B. Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

   C. Fire-retardant treatment data for materials impregnated by pressure process to reduce combustibility. Include certification by treating plant that treated materials comply with requirements.

   D. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

   E. Samples for verification purposes of the following:

      1. Laminate clad panel product, 8-1/2 inches by 11 inches by 1 1/4 inches, with wood edging. Use specified finish for laminate and wood edging on sample.
      2. Lumber with or for transparent finish, 50 square inches, for each species and cut, finished on one side and one edge.
      3. Lumber and panel products with factory-applied opaque finish, 8-1/2 inches by 11 inches for panels and 50 square inches for lumber, for each finish system and color, with one half of exposed surface finished.
      4. Perforated stainless steel metal panel
      5. Solid quartz with ogee edge, 12 inches x 12 inches (not used)
      6. Translucent glass with st. stl. clip top and bottom, 12 inches x 12 inches. (not used)

   F. Qualification data for firm proposed to do the work of this section: Woodworker must have a minimum of 10 years of experience in New York City. Woodworker must be a member of the Architectural Woodworking Institute (A.W.I.)

5. QUALITY ASSURANCE:

   A. Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

C. Installer Qualifications: Arrange for installation of architectural woodwork by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this project.

D. AWI Quality Standard: Woodworker, whether or not a member of the A.W.I. as required in this contract, must comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

6. DELIVERY, STORAGE, AND HANDLING:

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. No storage is available for architectural woodwork. Coordinate delivery and installation accordingly.

C. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

7. PROJECT CONDITIONS:

A. Environmental Conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacture of woodwork without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

8. HIGH PRESSURE DECORATIVE LAMINATE MANUFACTURERS:

A. Manufacturer: Architect will choose high pressure decorative laminates from one or more of the following:

1. Wilsonart

9. STANDARDS:

A. General: Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

1. Hardboard: ANSI/AHA A135.4
2. Medium Density Fiberboard: ANSI A208.2.
3. Particleboard: ANSI A208.1
4. Softwood Plywood: PS 1.
5. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:

a. Particleboard: NPA 8.
b. Medium Density Fiberboard: NPA 9.
c. Hardwood Plywood: HPMA FE.

B. Fire-Retardant Particleboard: Provide panels complying with the following requirements that have fire-retardant chemicals bonded to softwood particles at time of panel manufacture to achieve products identical to those tested for flame spread of 20 or less and for smoke developed of 25 or less per ASTM E 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

10. FABRICATION, GENERAL:

A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of cabinets and edges of solid wood (lumber) members less than 1 inch in nominal thickness: 1/16 inch.
2. Edges of rails and similar members more than 1 inch in nominal thickness: 1/8 inch.

C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

11. FIRE-RETARDANT-TREATED LUMBER:

A. General: All woodwork on this Project to be made of fire-retardant-treated lumber. Pressure impregnate lumber with fire-retardant chemicals of formulation indicated to produce materials with fire performance characteristics specified.

2. For countertop with plumbing fixture, use water resistant fire retardant-treated lumber.

C. Fire-Retardant Chemicals: Use chemical formulations specified that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated lumber from untreated lumber.

12. FASTENERS AND ANCHORS:

A. Provide concealed fasteners and anchors unless otherwise indicated.

B. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S-111 for applicable requirements.

1. For metal framing supports, provide screws as recommended by metal framing manufacturer.

C. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

D. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

13. ALL WOODWORK IN THIS SECTION:

A. Quality Standard: Comply with all appropriate AWI Standards.

B. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.

C. Assemble casings in plant except where limitations of access to place of installation require field assembly.

14. ARCHITECTURAL CABINET WORKS AND BOOKCASES:

A. Quality Standard: Comply with AWI Section 400L.

B. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.

C. Assemble casings in plant except where limitations of access to place of installation require field assembly.

15. CABINET HARDWARE AND ACCESSORY MATERIALS:

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets as follows:
- All hinges to be commercial grade, heavy-duty, European-style, concealed and self-closing.
- All pulls to be Hafele surface-mounted, Stainless Steel, Stainless Steel & Zinc - 96 mm CTC - Item no. 155.00.960
- All adjustable shelf supports to be steel paddle/peg style for insertion into bored holes in cabinet sides.
- All drawer slides shall be Medium Duty Steel Ball Bearing side mount, with silencing, full extension travel and a load rating of 75 lbs.

B. Hardware Standard: Comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.

C. Submit shop drawings of all cabinet hardware (along with shop drawings of woodwork for approval).

16. LAMINATE SHELVES

A. Quality Standard: Comply with AWI Section 400 and its Division 400C.

17. SOLID POLYMER COUNTERTOP:

A. Quality Standard: Comply with AWI Section AWI/ISFA 0661 – Cast Polymer Fabrications

1. Factory Finishing: To the greatest extent possible, finish architectural woodwork at factory. Defer only final touch-up, cleaning, and polishing until after installation.

B. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

C. Daltile, Natural Quartzite 2cm Natural Stone Slab, on marine plywood back up, with square edges and integral 4” high backsplash

18. STEEL TUBE SUPPORT LEGS FOR COUNTERTOPS (not used):

A. Size: Circular Tube: 2 inch diameter at Reception Desks and 1-1/2 inch diameter elsewhere. 1/8" x length shown on drawings

B. Finish: All cut edges to be filed to create smooth straight surfaces. Tube at Reception Desks: brushed stainless steel. Elsewhere: factory primed for final painting in field. Architect to supply finish paint color.

C. Fastenings: Note that all fastenings are concealed.

19. SHELF STANDARDS AND BRACKETS:

1. Provide chrome finish shelf standards, brackets, and shelf supports for wall-mounted, adjustable shelving, as manufactured by Fixture Hardware (Ph. 718-499-9422), no substitutions. Product #□s are as follows:

-Single slotted standards: #531 (extra heavy duty□)
-Double slotted standards: #519 (Heavy duty□)
-Brackets: #563
-Shelf Supports: #2041 (center rest)
Contractor/Manufacturer to confirm compatibility of all above components.

20. DECORATIVE METAL PANELS: (not used)

1. 1/8” thick perforated stainless steel sheet full length of each side of desk, finish: brushed

21. INSTALLATION:

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.

B. Install woodwork and masonite plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

22. ADJUSTMENT AND CLEANING:

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

23. PROTECTION:

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

END OF SECTION 064020

SECTION 072000 - BUILDING INSULATION

1. RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2. DESCRIPTION OF WORK

A. This Section includes the following:

1. Batt insulation required in walls, to meet R= 15

2. Rigid insulation required on the slab within the penthouse, to meet R = 30

B. Related Sections:

1. Section 075201 and 075202 (sloped insulation included in roofing system)

3. DEFINITIONS

A. Thermal Resistivity: Where the thermal resistivity of insulation products are designated by "r-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

4. SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of insulation product specified.

C. Product test reports from and based on tests performed by qualified independent testing laboratory evidencing compliance of insulation products with requirements including r-values (aged values for plastic foam insulations), fire performance characteristics, perm ratings, water absorption ratings, and other properties, based on comprehensive testing of current products.

5. QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristic: ASTM E 84.
2. Fire Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

B. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

C. Guarantee: Workmanship and materials in this Section to be covered by a (5) year guarantee.

6. DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

7. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide insulation products of one of the following:

1. Faced Mineral Fiber Blanket/Batt Insulation (Concealed Blanket/Batt Insulation in new Interior Partitions):

a. Insulation Systems
b. Owens Corning

2. Rigid Insulation/Extruded Polystyrene Board Insulation:

1. Amoco Foam Products Co.
2. Diversifoam Products.
3. Dow: The Dow Chemical Company
4. UC Industries, inc.

8. INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

B. Faced Mineral Fiber Blanket/Batt Insulation: ASTM C 665 for Type III, Class A; foil-scrim-kraft or foil-scrim-polyethylene vapor-retarder membrane on one face; and as follows:

1. Mineral Fiber Type: Fibers manufactured from glass or slag.

2. Surface Burning Characteristics: Maximum flame spread and smoke developed value of 50

respectively.

C. Rigid Insulation/Extruded Polystyrene Board Insulation:

1. Extruded Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C578 for type indicated; with 5-year aged r-values of 5.4 and 5 at 40 and 75 deg F (4.4 and 23.9 deg c), respectively; and as follows:

1. Type IV, 1.6 pcf min, density, unless otherwise indicated.
2. Type V, 3.0 pcf min. density where indicated.
3. Type VI, 1.8 pcf min. density.
4. Type VII, 2.2 pcf min. density.
5. Type X, 1.35 pcf min. density.
6. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 75 and respectively.

9. AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding either insulation, anchors, or substrates.

B. Adhesively Attached Pin Anchors: Perforated plate, 2 inches square, welded to projecting pin, with self-locking washer, complying with the following requirements:

1. Plate: Zinc-plated steel, 0.106 inch thick.
2. Pin: Copper-coated low carbon steel, fully annealed, 0.106 inches in diameter, length to suit depth of insulation indicated and, with washer in place, to hold insulation tightly to substrate behind insulation.
3. Self-Locking Washer: Mild steel, 0.016 inch thick, size as required to hold insulation securely.
. Where spindles will be exposed to human contact after installation, protect ends with capped self-locking washers.

10. EXAMINATION

A. Examine substrates and conditions with Installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

11. PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections that might puncture vapor retarders.

B. Close off openings in cavities receiving poured-in-place insulation to prevent the escape of insulation. Provide bronze or stainless steel screen (inside) where openings must be maintained for drainage or ventilation.

12. INSTALLATION, GENERAL

A. Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

B. Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections that interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

13. INSTALLATION OF CAVITY-WALL AND MASONRY-CELL INSULATION (Not Applicable)

14. INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

1. On vertical surfaces, set unit in adhesive applied in accordance with manufacturer□s instructions. Use type of adhesive recommended by manufacturer of insulation.

2. Protect below-grade insulation on vertical surfaces (from damage during back-filling by application of protection board. Set in adhesive in accordance with recommendations of manufacturer of insulation.

3. Project top surface of horizontal insulation (from damage during concrete work) by application of protection board.

15. INSTALLATION OF GENERAL BUILDING INSULATION

1. Apply insulation units to substrate by method indicated, complying with manufacturer□s recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

2. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in competed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

3. Set vapor retarder faced units with vapor retarder to warm side of construction, except as otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.

    1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

4. Set reflective, foil-faced units accurately with not less than 0.75-inch air space in front of foil as indicated.

5. Place glass fiber loose fill insulation into spaces and into surfaces as shown, either by pouring or by machine-blowing. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not excessively compact.

6. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

16. PROTECTION

A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072000

STO GUIDE SPECIFICATION L100G – StoTherm ci Lotusan

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1.3 REFERENCES

A. ASTM Standards:

B 117	Test Method for Salt Spray (Fog) Testing
C 297	Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
C 578	Specification for Preformed, Cellular Polystyrene Thermal Insulation
C 1177	Specification for Glass Mat Gypsum for Use as Sheathing
C 1382	Test Method for Determining Tensile Adhesion Properties of Sealants When Used in Exterior Insulation and Finish Systems (EIFS) Joints
D 968	Test Method for Abrasion Resistance of Organic Coatings by Falling Abrasive
D 1784	Specification for Rigid Poly (Vinyl Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
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G 154	Recommended Practice for Operating Light-and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

B. Building Code Standards

AC 235	Acceptance Criteria for EIFS Clad Drainage Wall Assemblies (November, 2009)

C. National Fire Protection Association (NFPA) Standards

NFPA 268	Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source
NFPA 285	Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus

D. Other Referenced Documents

1. American Association of Textile Chemists and Colorists AATCC-127 Water Resistance: Hydrostatic Pressure Test
2. APA Engineered Wood Association E 30, Engineered Wood Construction Guide
3. ICC-ES ESR-1233, StoGuard with Gold Coat, StoGuard with EmeraldCoat, and StoGuard VaporSeal Water-Resistive Barriers and StoEnergy Guard
4. ICC-ES ESR-1748, StoTherm® ci

1.4 DESIGN REQUIREMENTS

A. Wind Load

1. Design for maximum allowable system deflection, normal to the plane of the wall, of L/240.

2. Maximum wind load resistance: 55 psf, provided structural supports and sheathing/sheathing attachment are adequate to resist these pressures.

B. Moisture Control

1. Prevent the accumulation of water behind the EIFS or into the wall assembly, either by condensation or leakage through the wall construction, in the design and detailing of the wall assembly:

   a. Provide flashing to direct water to the exterior where it is likely to penetrate components in the wall assembly, including, above window and door heads, beneath window and door sills, at roof/wall intersections, decks, abutments of lower walls with higher walls, above projecting features, at floor lines, and at the base of the wall.

   b. Air Leakage Prevention – provide continuity of the air barrier system at foundation, roof, windows, doors, and other penetrations through the wall with connecting and compatible air barrier components to minimize condensation and leakage caused by air movement.

   c. Vapor Diffusion and Condensation – perform a dew point analysis and/or dynamic hygrothermal modeling of the wall assembly to determine the potential for accumulation of moisture in the wall assembly by diffusion. Adjust insulation thickness and/or other wall assembly components accordingly to minimize risk. Avoid the use of vapor retarders on the interior side of the wall in warm, humid climates.

C. Impact Resistance

1. Provide ultra-high impact resistance of the EIFS to a minimum height of 6'-0" (1.8 m) above finished grade at all areas accessible to pedestrian traffic and other areas exposed to abnormal stress or impact. Indicate the areas with impact resistance other than “Standard” on contract drawings.

D. Color Selection

1. Architect will select finish coat with a light reflectance value of 20 or greater. (The use of dark colors is not recommended over expanded polystyrene [EPS]. EPS has a service temperature limitation of approximately 165° F [74°C]).

E. Joints

1. Provide minimum 3/4 inch (19 mm) wide joints in the EIFS where they exist in the substrate or supporting construction, where the cladding adjoins dissimilar construction or materials, at changes in building height, at expansion, control, and cold joints in construction, and at floor lines in multi-level wood frame construction. Size joints to correspond with anticipated movement. Align terminating edges of EIFS with joint edges of through wall expansion joints and similar joints in construction. Refer to Sto Details.

2. Provide minimum 1/2 inch (13 mm) wide perimeter sealant joints at all penetrations through the EIFS (windows, doors, mechanical, electrical, and plumbing penetrations, etc.).

3. Specify compatible backer rod and sealant that has been evaluated in accordance with ASTM C 1382, and that meets minimum 50% elongation after conditioning.

4. Provide joints so that air barrier continuity is maintained across the joint, and drain joints to the exterior, or provide other means to prevent or control water infiltration at joints.

F. Grade Condition

1. Do not specify the EIFS below grade (unless designed for use below grade and permitted by code) or for use on surfaces subject to continuous or intermittent water immersion or hydrostatic pressure. Provide minimum 6 inch (152 mm) clearance above grade or as required by code.

G. Trim, Projecting Architectural Features and Reveals

1. All trim and projecting architectural features must have a minimum 1:2 [27°] slope along their top surface. All reveals must have minimum ¾ inch (19 mm) insulation thickness at the bottom of the reveal. All horizontal reveals must have a minimum 1:2 [27°] slope along their bottom surface. Increase slope for northern climates to prevent accumulation of ice/snow and water on surface. Where trim/feature or bottom surface of reveal projects more than 2 inches (51 mm) from the face of the EIFS wall plane, protect the top surface with waterproof base coat. Periodic inspections and increased maintenance may be required to maintain surface integrity of the EIFS finish on weather exposed sloped surfaces. Limit projecting features to easily accessible areas and limit total area to facilitate and minimize maintenance. Refer to Sto Details.

2. Do not use the EIFS on weather exposed projecting ledges, sills, or other projecting features unless supported by framing or other structural support and protected with metal coping or flashing. Refer to Sto Detail 10.61.

H. Insulation Thickness

1. Insulation in EIFS system must meet R15

I. Fire Protection

1. Do not use EPS foam plastic in excess of 12 inches (305 mm) thick on types I, II, III, or IV construction unless approved by the code official.

2. Where a fire-resistance rating is required by code use the EIFS over a rated concrete or concrete masonry assembly. Limit use over rated frame assemblies to non-load bearing assemblies (the EIFS is considered not to add or detract from the fire-resistance of the rated assembly). Maximum allowable EPS thickness: 4 inches (102 mm).

3. Refer to manufacturer's testing or applicable code compliance report for other limitations that may apply.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with ASTM E 2570 (Air/Moisture Barrier) and ASTM E 2568 (EIFS)

Table 1 Air/Moisture Barrier Performance

TEST	METHOD	CRITERIA	RESULT
1. Weathering	AATCC 127 (Water Column)	No cracking, bond failure or water penetration after 210 hours UV exposure, 25 wet/dry cycles, and 21.6 in (55 cm) water column	Pass

TEST	METHOD	CRITERIA	RESULT
2. Durability	ASTM E 1233/ ASTM E 72 / ASTM E 331	No cracking or water penetration at sheathing joints after 10 cycles transverse loading, 1 cycle racking, 5 cycles environmental conditioning, and 15 minutes water spray at 2.86 psf (137 kPa) pressure differential	No water penetration
3. Water Resistance	ASTM D 2247	Absence of deleterious effects after 14 day exposure	No deleterious effects
4. Water Vapor Transmission	ASTM E 96 Method B (Water Method)	Measure	Sto Gold Coat: > 10 perms [574 ng/(Pa·s·m^2)] Sto AirSeal; >12 perms [689 ng/ (Pa s m^2)]
5. Air Leakage (material)	ASTM E 2178	≤ 0.004 cfm/ft2 at 1.57 psf (0.02 L/s•m2 at 75 Pa)	Pass
6. Air Leakage (assembly)	ASTM E 2357	≤ 0.04 cfm/ft2 (0.2 L/s•m2)	Pass[1]
7. Freeze-Thaw	ASTM E 2485	No delamination or surface changes after 10 cycles when viewed under 5X magnification	No delamination or surface changes
8. Surface Burning	ASTM E 84	Flame Spread less than or equal to 25 Smoke developed less than or equl to 450	Flame Spread: < 25 Smoke Density: < 450
9. Tensile Bond	ASTM C 297	Greater than 15 psi (103 kPa)	Pass over Plywood, OSB, Glass Mat Faced Gypsum sheathings, CMU

1. Based on testing of air barrier joint treatment material at sheathing joints and no top coat

Table 2 EIFS Weather Resistance and Durability Performance*

TEST	METHOD	CRITERIA	RESULTS
1. Accelerated Weathering	ASTM G 153 (Formerly ASTM G 23)	No deleterious effects* at 2000 hours when viewed under 5x magnification	Pass
2. Accelerated Weathering	ASTM G 154 (Formerly ASTM G 53)	No deleterious effects* at 2000 hours	Pass
3. Freeze/Thaw Resistance	ASTM E 2485	No deleterious effects* at 10 cycles when viewed under 5x magnification	Pass
4. Water Penetration	ASTM E 331 (modified per ICC-ES AC 235)	No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes at 6.24 psf (299 Pa) or 20% of design wind pressure, whichever is greater	Pass at 12.0 psf (575 Pa) after 30 minutes
5. Drainage Efficiency	ASTM E 2273	90% minimum	> 90%
6. Tensile Adhesion	ASTM E 2134	Minimum 15 psi (103kPa) tensile strength	Pass

TEST	METHOD	CRITERIA	RESULTS
7. Water Resistance	ASTM D 2247	No deleterious effects*at 14 day exposure	Pass @ 28 days
8. Salt Spray	ASTM B 117	No deleterious effects* at 300 hours	Pass @ 300 hrs
9. Abrasion Resistance	ASTM D 968	No cracking or loss of film integrity at 528 quarts (500 L) of sand	Pass @ 528 quarts (1000 L)
10. Mildew Resistance	ASTM D 3273	No growth supported during 28 day exposure period	Pass @ 28 days
11. Impact Resistance	ASTM E 2486	Standard: 25-49 in-lbs (2.83-5.54J) Medium: 50-89 in-lbs (5.65-10.1J) High: 90-150 in-lbs (10.2-17J) Ultra-High: >150 in-lbs (>17J)	Pass with one layer Sto Mesh Pass with two layers Sto Mesh Pass with one layer Sto Intermediate Mesh Pass with one layer Sto Armor Mat and one layer Sto Mesh

* No deleterious effects: no cracking, checking, crazing, erosion, rusting, blistering, peeling or delamination

Table 3 Air/Moisture Barrier and EIFS Fire Performance

TEST	METHOD	CRITERIA	RESULT
1. Fire Endurance	ASTM E 119	Maintain fire resistance of existing rated assembly	Pass (4 inch [102 mm] maximum allowable insulation thickness)
2. Intermediate Scale Multi-Story Fire Test	NFPA 285 (formerly UBC Standard 26-9)	1. Resistance to vertical spread of flame within the core of the panel from one story to the next 2. Resistance to flame propagation over the exterior surface 3. Resistance to vertical spread of flame over the interior surface from one story to the next 4. Resistance to significant lateral spread of flame from the compartment of fire origin to adjacent spaces	Pass with 12 inches (305 mm) insulation
3. Radiant Heat Ignition	NFPA 268	No ignition @ 20 minutes	Pass with 1 and 12 inches (25 and 305 mm) insulation
4.Surface Burning (individual components)	ASTM E 84	Individual components shall each have a flame spread of 25 or less, and smoke developed of 450 or less	Flame Spread: < 25 Smoke Developed: < 450

Table 4 EIFS Component Performance

TEST	METHOD	CRITERIA	RESULT
1. Alkali Resistance of Reinforcing Mesh	ASTM E 2098	Greater than 120 pli (21 dN/cm) retained tensile strength	Pass
2. Requirements for Rigid PVC Accessories	ASTM D 1784	Meets cell classification 13244C	Pass

1.6 QUALITY ASSURANCE

A. Manufacturer Requirements

1. Member in good standing of the EIFS Industry Members Association (EIMA)
2. Air/moisture barrier and EIFS manufacturer for a minimum of thirty (30) years
3. Manufacturing facilities ISO 9001:2008 Certified Quality System and ISO 14001:2004 Certified Environmental Management System

B. Contractor Requirements

1. Engaged in application of similar systems for a minimum of three (3) years
2. Knowledgeable in the proper use and handling of Sto materials
3. Employ skilled mechanics who are experienced and knowledgeable in air/moisture barrier and EIFS application, and familiar with the requirements of the specified work
4. Successful completion of minimum of three (3) projects of similar size and complexity to the specified project
5. Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with Sto's published specifications and details and the project plans and specifications
6. Installers in Project Area (list provided by manufacturer)

C. Insulation Board Manufacturer Requirements

1. EPS board listed by an approved agency
2. EPS board manufactured under Sto licensing agreement and recognized by Sto as being capable of producing EPS insulation board to meet EIFS requirements
3. EPS board labeled with information required by Sto, the approved listing agency, and the applicable building code.

D. Mock-up Testing

1. Construct full-scale mock-up of typical air/moisture barrier and EIFS/window wall assembly with specified tools and materials and test air and water infiltration and structural performance in accordance with ASTM E 283, ASTM E 331 and ASTM E 330, respectively, through independent laboratory. Mock-up shall comply with requirements of project specifications. Where mock-up is tested at job site maintain approved mock-up at site as reference standard. If tested off-site accurately record construction detailing and sequencing of approved mock-up for replication during construction.

E. Inspections

1. Provide independent third party inspection where required by code or contract documents
2. Conduct inspections in accordance with code requirements and contract documents

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product

B. Protect coatings (pail products) from freezing and temperatures in excess of 90°F (32° C). Store away from direct sunlight.

C. Protect Portland cement based materials (bag products) from moisture and humidity. Store under cover off the ground in a dry location.

1.8 PROJECT/SITE CONDITIONS

(Weather conditions affect application and drying time of most products. Hot or dry conditions limit working time and accelerate drying and may require adjustments in the scheduling of work to achieve desired results; cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing)

A. Maintain ambient and surface temperatures above 40°F (4°C) during application and drying period, minimum 24 hours after application of Air/Moisture barrier and EIFS products

B. Provide supplementary heat for installation in temperatures less than 40°F (4°C)

C. Provide protection of surrounding areas and adjacent surfaces from application of products

1.9 COORDINATION/SCHEDULING

(The work in this section requires close coordination with related sections and trades. Sequence work to provide protection of construction materials from weather deterioration)

A. Provide site grading such that the EIFS terminates above grade a minimum of 6 inches (150 mm) or as required by code

B. Coordinate installation of foundation waterproofing, roofing membrane, windows, doors and other wall penetrations to provide a continuously connected air and moisture barrier

C. Provide protection of rough openings before installing windows, doors, and other penetrations through the wall

D. Install window and door head flashing immediately after windows and doors are installed

E. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior

F. Install splices or tie-ins from air/moisture barrier over back leg of flashings, starter tracks, and similar details to form a shingle lap that directs incidental water to the exterior

G. Install copings and sealant immediately after installation of the EIFS when coatings are dry, and such that, where sealant is applied against the EIFS surface, it is applied against the base coat or primed base coat surface

H. Schedule work such that air/moisture barrier is exposed to weather no longer than 180 days if Sto Gold Coat is used, 90 days if Sto AirSeal is used.

I. Attach penetrations through the EIFS to structural support and provide water tight seal at penetrations

1.10 WARRANTY

A. Provide manufacturer's standard warranty

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide Air/Moisture Barrier and EIFS coatings and accessories from single source manufacturer or approved supplier

B. The following are acceptable manufacturers:

1. Sto Corp. – Air/Moisture Barrier, EIFS
2. Plastic Components, Inc. – EIFS Accessories

2.2 AIR/MOISTURE BARRIER

A. StoGuard

1. Joint Treatment, Rough Opening Protection, and Detail Components:
   a. Sto Gold Coat® – ready mixed coating applied by brush, roller or spray for rough opening protection of frame walls and joint treatment of sheathing when used with StoGuard Fabric. Also used as a detail component with StoGuard Fabric to splice over back flange of starter track, flashing, and similar ship lap details
   b. Sto RapidGuard® - one component STPE rapid drying gun-applied treatment for sheathing joints, rough openings, seams, cracks, penetrations and other transitions in above grade wall construction.
2. Waterproof Coating*:*
   a. Sto Gold Coat – ready mixed waterproof coating for concrete, concrete masonry, wood-based sheathing, and glass mat gypsum sheathing
3. Transition Detail Components
   a. StoGuard Transition Membrane – flexible air barrier membrane for continuity at static transitions such as sheathing to foundation, dissimilar materials (CMU to frame wall), wall to balcony floor slab or ceiling, and shingle lap transitions to flashing. Also used for dynamic joints: floor line deflection joints, masonry control joints, and through wall joints in masonry or frame construction
   b. Sto RapidGuard: one component STPE rapid drying gun-applied treatment for sheathing joints, rough openings, seams, cracks, penetrations and other static transitions in above grade wall construction such as: shingle lap transitions to flashing, wall to balcony floor slab or ceilings, and through wall penetrations – pipes, electrical boxes, and scupper penetrations.

2.3 ADHESIVE

A. Sto TurboStick™ – one component polyurethane spray foam adhesive

B. Sto BTS Plus – factory blended one-component polymer-modified portland cement based high build adhesive

C. Sto BTS Xtra – lightweight factory blended one-component polymer-modified portland cement based high build adhesive

2.4 INSULATION BOARD

A. Sto EPS Insulation Board: nominal 1.0 lb/ft^3 (16 kg/m^3) Expanded Polystyrene (EPS) insulation board in compliance with ASTM E 2430 and ASTM C 578 Type I requirements and listed, labeled, and furnished in accordance with Section 1.6C.

2.5 BASE COAT

A. Cementitious Base Coat

1. Sto BTS Plus – factory blended one component polymer modified portland cement based high build base coat. Also used as a leveler for concrete and masonry surfaces
2. Sto BTS Xtra – lightweight factory blended one component polymer modified portland cement based high build base coat. Also used as a leveler for concrete and masonry surfaces

B. Waterproof Base Coat

1. Sto Flexyl – fiber reinforced acrylic based waterproof base coat mixed with portland cement (for use as a waterproof base coat over Sto BTS Plus or BTS Xtra for foundations, parapets, splash areas, trim and other projecting architectural features)

2.6 REINFORCING MESHES

A. Standard Mesh (Note: this is used everywhere as the final mesh on all EIFS façade areas on the project)

2. Sto Mesh – nominal 4.5 oz/yd^2 (153 g/m^2), symmetrical, interlaced open-weave glass fiber fabric made with alkaline resistant coating for compatibility with Sto materials *(achieves Standard Impact Classification)*

B. Ultra-High Impact Mesh (Note: this is used from 0'-0" to 6'-0" as an initial coat on the walls that are accessible from the roof area (two sides of the penthouse and roof side of the parapets). Then the Standard Mesh (item a. above) goes over this and all other EIFS facade areas on the project.

3. Sto Armor Mat – nominal 15 oz/yd^2 (509 g/m^2), ultra-high impact, double strand, interwoven, open-weave glass fiber fabric with alkaline resistant coating for compatibility with Sto materials *(recommended to a minimum height of 6'-0" [1.8m] above finished grade at all areas accessible to pedestrian traffic and other areas exposed to abnormal stress or impact. Achieves Ultra-High Impact Classification when applied beneath Sto Mesh)*

2.5 PRIMER

A. StoPrime Sand – acrylic based tintable primer with sand for roller application

2.6 FINISH COAT

A. Stolit® Lotusan® – acrylic based textured wall finish with graded marble aggregate and self-cleaning properties

2.7 JOB MIXED INGREDIENTS

A. Water – clean and potable

B. Portland cement – Type I, Type II, or Type I-II in conformance with ASTM C 150

2.8 ACCESSORIES

A. Starter Track – rigid PVC (polyvinyl chloride) plastic track Part No. STDE as furnished by Plastic Components, Inc., 9051 NW 97th Terrace, Miami, FL 33178 (800 327 – 7077).

B. Sto-Mesh Corner Bead Standard – one component PVC (polyvinyl chloride) accessory with integral reinforcing mesh for outside corner reinforcement.

C. Sto Drip Edge Profile - one component PVC (polyvinyl chloride) accessory with integral reinforcing mesh that creates a drip edge and plaster return

2.9 MIXING

A. Sto Gold Fill – mix with a clean, rust-free high speed mixer to a uniform consistency

B. Sto Gold Coat – mix with a clean, rust-free high speed mixer to a uniform consistency

C. Sto AirSeal – mix with a clean, rust-free high speed mixer to a uniform consistency

D. Sto BTS Plus – mix ratio with water: 5-6.5 quarts (4.7-6.2 L) of water per 47 pound (21.3 kg) bag of Sto BTS Plus. Pour water into a clean mixing pail. Add Sto BTS Plus, mix to a uniform consistency and allow to set for approximately 5 minutes. Adjust mix if necessary with additional Sto BTS Plus or water and remix to a uniform trowel consistency. Avoid retempering. Keep mix ratio consistent. Do not exceed maximum water amount in mix ratio.

E. Sto BTS Xtra – mix ratio with water: 4.75- 5 quarts (4.5-4.7 L) of clean potable water per 38 pound (17.2 kg) bag of Sto BTS Xtra. Pour water into a clean mixing pail. Add Sto BTS Xtra, mix to a uniform consistency and allow to set for approximately 5 minutes. Adjust mix if necessary with additional Sto BTS Xtra or water and remix to a uniform trowel consistency. Avoid retempering. Keep mix ratio consistent. Do not exceed maximum amount of water in mix ratio.

F. Sto Flexyl – mix ratio with portland cement: 1:1 ratio by weight. Pour Sto Flexyl into a clean mixing pail. Add portland cement, mix to a uniform consistency and allow to set for approximately five minutes. Adjust mix if necessary with additional Sto Flexyl and remix to a uniform trowel consistency. Avoid retempering. Keep mix ratio consistent.

G. Sto Watertight Coat – pour liquid component into a clean mixing pail. Add dry component, mix to a uniform consistency and allow to set for approximately five minutes. Adjust mix if necessary and remix to a uniform trowel consistency. Avoid retempering. Keep mix ratio consistent.

H. Sto primer – mix with a clean, rust-free high speed mixer to a uniform consistency

I. Stolit Lotusan – mix with a clean, rust-free high speed mixer to a uniform consistency. A small amount of water may be added to adjust workability. Limit addition of water to amount needed to achieve the finish texture.

J. Mix only as much material as can readily be used

K. Do not use anti-freeze compounds or other additives

PART 3 EXECUTION

3.0 PRECONSTRUCTION CONFERENCE

A. Preconstruction Conference with STO, Installer, and the Architect is required prior to proceeding with the work.

3.1 ACCEPTABLE INSTALLERS

Approved installers in area of this project (provided by mfr.):

A. Colonial Wall Systems
17 Selover Rd
Whitehouse Station, NJ 08889
estimating@colonialwall.com
Owner-Viktor Urban (732)-484-9730
Estimator- Mark Mucha (908)-287-1778

B. Elite Wall Systems
289A Suburban Ave
Deer Park, NY 11729
estimating@elitewallsys.com
Chief Estimator- Anil Pachunuri
(631)-422-1634
(516)-286-2815

C. J&A Plastering Corp
210 Boss Rd
Syracuse, NY 13211
Joseph@j-aplastering.com
Owner- Joseph DiBello
Office (315)-437-0264
Cell (315)-437-0264

D. Doran & Tatrow Associates
14 Storrs Court
Mahwah, NJ 07430
PDoranDTA@msn.com
Owner- Pat Doran (201)-522-6667

3.2 EXAMINATION

A. Inspect concrete and masonry substrates prior to start of application for:
1. Contamination—algae, chalkiness, dirt, dust, efflorescence, form oil, fungus, grease, laitance, mildew or other foreign substances

2. Surface absorption and chalkiness
3. Cracks—measure crack width and record location of cracks
4. Damage and deterioration such as voids, honeycombs and spalls
5. Moisture content and moisture damage—use a moisture meter to determine if the surface is dry enough to receive the products and record any areas of moisture damage
6. Compliance with specification tolerances—record areas that are out of tolerance (greater than ¼ inch in 8-0 feet [6mm in 2438 mm] deviation in plane)

B. Inspect sheathing application for compliance with applicable requirement and installation in conformance with specification and manufacturer requirements:

1. Glass Mat Faced gypsum sheathing compliant with ASTM C 1177
2. Exterior Grade and Exposure I wood based sheathing – APA Engineered Wood Association E 30
3. Cementitious sheathing – consult manufacturer
4. Attachment into structural supports with adjoining sheets abutted (gapped if wood-based sheathing) and fasteners at required spacing to resist design wind pressures as determined by design professional
5. Fasteners seated flush with sheathing surface and not over-driven

C. Report deviations from the requirements of project specifications or other conditions that might adversely affect the Air/Moisture Barrier and the EIFS installation to the General Contractor. Do not start work until deviations are corrected.

3.3 SURFACE PREPARATION

A. Remove surface contaminants on concrete, concrete masonry, gypsum sheathing, or coated gypsum sheathing surfaces

B. Repair cracks, spalls or damage in concrete and concrete masonry surfaces and level concrete and masonry surfaces to comply with required tolerances

C. Apply conditioner (consult Sto) by spray or roller to chalking or excessively absorptive surfaces or pressure wash to remove surface chalkiness

D. Remove fasteners that are not anchored into supporting construction and seal holes with air barrier material

E. Seal over-driven fasteners with air barrier material and install additional fasteners as needed to comply with fastener spacing requirement

F. Fill large gaps between sheathing or voids around pipe, conduit, scupper, and similar penetrations with spray foam and shave flush with surface (refer to Sto Details)

G. Replace weather-damaged sheathing and repair or replace damaged or cracked sheathing

3.4 INSTALLATION

NOTE: The air/moisture barrier described below is one set of materials in the air barrier system and the moisture protection for the structure. Installation of the air/moisture barrier must be integrated with flashing and other air and moisture barrier materials to ensure that where

water is likely to penetrate the wall assembly, it will be drained to the exterior at the source of the leak. Proper air barrier connections and integration of the air/moisture barrier through proper sequencing of work and coordination of trades is necessary for a complete air barrier system and complete moisture protection.

IMPORTANT: ***Ensure the air/moisture barrier surface (Sto Gold Coat), insulation board surface, and reinforced base coat surface are free of surface contamination. Install Sto EPS Insulation Board within 180 days of the application of Sto Gold Coat, or within 90 days of the application of Sto AirSeal.***

3.4.1 Air/Moisture Barrier Installation over Exterior or Exposure I Wood-Based Sheathing (Plywood and OSB), Glass Mat Faced Gypsum Sheathing in Compliance with ASTM C 1177, and Concrete, or Concrete Masonry (CMU) Wall Construction

A. Transition Detailing

1. Detail transition areas with Sto RapidGuard or StoGuard Transition Membrane to achieve air barrier continuity. For illustrations of installation, refer to Sto guide Details and Sto RapidGuard Installation Guide or StoGuard Transition Membrane Installation Guide (www.stocorp.com)

B. Rough Opening Protection *(select 1, 2, 3 or 4 for frame construction; for concrete or concrete masonry rough openings with wood bucks and similar openings with complex 3-dimensional geometry, select no. 3 or 4, Sto RapidGuard or StoGuard RapidSeal):*

1. Sto Gold Fill with StoGuard Mesh: apply 9 inch (229 mm) wide StoGuard Mesh at rough openings. Immediately apply Sto Gold Fill by spray or trowel over the mesh and spread with a trowel to create a smooth surface that completely covers the mesh (refer to Sto Detail 20.20M).

2. Sto Gold Coat or Sto AirSeal with StoGuard Fabric: apply coating liberally by spray or roller to corners of openings, immediately place StoGuard RediCorners in the wet coating, and apply additional coating over the RediCorners to completely embed them. After all corners have been completed apply coating liberally to the entire rough opening, immediately place StoGuard Fabric in the wet coating, smooth any wrinkles with a brush or roller, and apply additional coating over the fabric to completely embed it. Overlap all seams minimum 2 inches (51 mm). Once completed top coat with additional coating as needed to completely seal the surface. Allow to dry and inspect for pinholes or voids. If pinholes or voids are present, seal with additional coating or StoGuard RapidSeal (refer to Sto Detail 20.20F).

3. Sto RapidGuard: apply a fillet bead of material with a caulking gun at interior corners inside the opening to seal jamb/sill and jamb/head seams. Apply material in a zig-zag pattern along sill, jambs, and head to form a generous bead of material along the surface to be covered. Use a 6 inch (152 mm) wide plastic drywall knife to spread the material to a uniform thickness of 12-20 mils (0.3-0.5 mm) before the material skins. Treat the entire rough opening surface in this manner and overlap onto the face of the sheathing 2 inches (51 mm) minimum all the way around.

C. Sheathing Joint Treatment *(select one)*

1. Sto Gold Fill with StoGuard Mesh: place 4 inch (102 mm) wide mesh centered along sheathing joints and minimum 9 inch (229 mm) wide mesh centered and folded at inside and outside corners. Immediately apply Sto Gold Fill by spray or trowel and spread with a trowel to create a smooth surface that completely covers the mesh.

2. Sto Gold Coat or Sto AirSeal with StoGuard Fabric: apply coating liberally by spray or roller along sheathing joints and immediately place 4 inch (102 mm) wide fabric centered over the joints into the wet coating, and 6 inch (152 mm) wide fabric centered and folded at inside and outside corners into the wet coating. Smooth any wrinkles with a brush or roller and apply additional coating to completely embed the fabric. Overlap seams minimum 2 inches (51 mm).

3. Sto RapidGuard: apply to properly installed sheathing - joints butted for gypsum sheathing, and joints gapped for plywood and OSB sheathings (wood-based sheathing typically requires 1/8 inch [3 mm] spacing at edge and end joints). Apply a thick bead of Sto RapidGuard with a caulking gun along sheathing joints, or apply in a zig-zag pattern across and down the joints. Spread to a uniform thickness of 20-30 mils (0.5-0.6 mm) before the material skins. Spread 1 inch (25mm) beyond the sheathing joint on each side. Follow the same procedure for inside and outside corners.

D. Air/Moisture Barrier Coating Installation

1. Plywood and Gypsum Sheathing: apply waterproof coating by spray or roller over sheathing surface, including the dry joint treatment, rough opening protection, and transition areas, to a uniform wet mil thickness of 10 mils in one coat (Sto Gold Coat) or 20 mils in one coat (Sto AirSeal). Use ½ inch (13 mm) nap roller for plywood. Use ¾ inch (19 mm) nap roller for glass mat faced gypsum sheathing. Protect from weather until dry.

2. OSB Sheathing: apply waterproof coating by spray or with a ¾ inch (19 mm) nap roller to sheathing surface to a uniform wet mil thickness in two coats of 10 wet mils each (Sto Gold Coat), or 20 mils in one coat (Sto AirSeal). Protect rough openings, joints, and parapets (Paragraph 3.04D), then apply a second coat of waterproof coating.

3. CMU Surfaces:

   a. Repair static cracks up to 1/2 inch (13 mm) wide with Sto RapidGuard or StoGuard RapidFill. Rake the crack with a sharp tool to remove loose or friable material and blow clean with oil-free compressed air. Apply the crack filler with a trowel or putty knife over the crack and tool the surface smooth. *(Note: For moving cracks or cracks larger than ½ inch [13mm]), consult with a structural engineer for repair method).* Protect repair from weather until dry.

   b. Liberally apply coating to the surface with a ¾ inch nap roller or spray equipment to a minimum wet thickness of 10 – 30 mils (Sto Gold Coat) or 20-40 wet mils (Sto AirSeal), depending on surface condition. Apply to a uniform thickness. Additional coats may be necessary to provide a void and pinhole free surface. Protect from weather until dry.

IMPORTANT: *The Sto coating functions as an air and moisture barrier on normal weight concrete masonry wall construction with flush (struck flush with the surface of the CMU) or concave joints when minimum two liberal coats are applied. Additional coats may be necessary depending on the condition of the CMU wall surface, CMU porosity, joint profile, and other variables that may exist. For "rough" CMU wall surfaces, skim coat the entire surface with one of Sto's cementious levelers (Sto BTS Plus or Sto BTS Xtra) before application of coating. A VOID AND PINHOLE FREE SURFACE must be achieved for the coating to properly function as an air and moisture barrier on CMU wall surfaces.*

E. Air /Moisture Barrier Connections and Shingle Laps

1. Coordinate installation of connecting air barrier components with other trades to provide a continuous air tight membrane.
2. Coordinate installation of flashing and other moisture protection components with other trades to achieve complete moisture protection such that water is directed to the exterior, not into the wall assembly, and drained to the exterior at sources of leaks (windows, doors and similar penetrations through the wall assembly).
3. Splice-in head flashings above windows, doors, floor lines, roof/sidewall step flashing, and similar locations with StoGuard detail component to achieve shingle lap of the air/moisture barrier such that water is directed to the exterior.

NOTE: Windows and doors are typically installed immediately following installation of the air/moisture barrier and work should be sequenced accordingly. Consult with window manufacturer for installation requirements to maintain air barrier continuity and for head, jamb, sill flashing and perimeter sealant requirements needed to prevent leaks into the wall assembly.

3.4.2 EIFS Installation

A. Starter Track

1. Strike a level line at the base of the wall to mark where the top of the starter track terminates.
2. Attach the starter track even with the line into structural supports with the proper fastener: Type S-12 corrosion resistant screws for steel framing with minimum 3/8 inch (9 mm) and three thread penetration, galvanized or zinc coated nails for wood framing with minimum 3/4 inch (19 mm) penetration, and corrosion resistant concrete or masonry screws with minimum 1 inch (25 mm) penetration for concrete or CMU. Attach between studs into blocking as needed to secure the track flat against the wall surface. Attach at maximum 16 inches (406 mm) on center into framing. For solid wood sheathing or concrete/masonry surfaces, attach directly at 12 inches (305 mm) on center maximum.
3. Butt sections of starter track together. Miter cut outside corners and abut. Snip front flange of one inside corner piece (to allow EPS insulation board to be seated inside of track) and abut.
4. Install Starter Track at other EIFS terminations as designated on detail drawings: above roof along dormers or gable end walls, and beneath window sills with concealed flashing (refer to Sto Details).

B. Detail Splice Strips for Starter Track, Flashing at Floor Lines, Head of Windows and Doors

1. Starter Track, Window/Door Head Flashing, Floor Line Flashing, and Roof/Side Wall Step Flashing: Install minimum 4 inch (100 mm) wide detail component over back flange of starter track, floor line flashing, head flashing, and roof/side wall step flashing. Center the detail component so it spans evenly between the back leg of flashing (or accessory) and the coated sheathing. Make a smooth transition to the coated sheathing with a trowel, knife, or roller, depending on the detail component material being used. When Sto Gold Fill with StoGuard Mesh is the detail component apply another coat of the waterproof coating over the detail area. Do not leave detail components exposed for more than 30 days.

C. Backwrapping

1. Apply a strip of detail mesh to the dry air/moisture barrier at all system terminations (windows, doors, expansion joints, etc.) except where the Starter Track is installed. The

mesh must be wide enough to adhere approximately 4 inches (100 mm) of mesh onto the wall, be able to wrap around the insulation board edge and cover a minimum of 2 ½ inches (64 mm) on the outside surface of the insulation board. Attach mesh strips to the air/moisture barrier and allow them to dangle until the backwrap procedure is completed (paragraph 3.04 G1). Alternatively, pre-wrap terminating edges of insulation board.

NOTE: Backwrapping can be replaced by "pre-wrapping" terminating edges of insulation board with Sto Mesh or Sto Detail Mesh embedded in the Sto base coat. This method is often preferred to facilitate installation in the field. This method may also be used in conjunction with flashing at the base of the wall, roof/wall intersections, floor lines, and similar terminations to replace the starter track.

D. Adhesive Application and Installation of Insulation Board

1. Ensure the air/moisture barrier surface (Sto Gold Coat) is free of surface contamination. Install the insulation board within 30 days of the application of the air/moisture barrier coating (Sto Gold Coat), or clean the surface and recoat with Sto Gold Coat.

2. Rasp the interior lower face of insulation boards to provide a snug friction fit into the Starter Track. *(Note: rasping prevents an outward bow at the Starter Track).*

3. Use either polyurethane spray foam adhesive (Sto TurboStick) or cementitous adhesive (Sto BTS Plus or Sto BTS Xtra):

a. Polyurethane Spray Foam Adhesive (Sto TurboStick): apply adhesive to the back of the insulation board with the dispensing pistol approximately ¾ inch (19 mm) from ends. Apply 5 additional ribbons spaced equally at no greater than 7 inches (177 mm) apart between the end ribbons. Apply uniform ribbons of adhesive parallel with the SHORT dimension of the board so that when boards are placed on the wall the ribbons will be VERTICAL. Apply adhesive ribbons approximately ½ inch (51 mm) in diameter which will expand to ¾ – 1 inch (19 – 25 mm). Keep adhesive ½ inch (51 mm) short of board edges. Apply adhesive uniformly so ribbons of adhesive do not converge. Allow adhesive to "dwell" and become "tacky" before placing boards on wall. Adhesive will look smooth, not jagged, when ready to apply to wall surface. Place boards while adhesive is "tacky" and before adhesive "skins".

IMPORTANT: Adhesive tack time varies with temperature and humidity. High temperature or high humidity decreases tack time. Low temperature or low humidity increases tack time. Generally adhesive will remain tacky between 1-5 minutes. If adhesive "skins" remove it and apply fresh adhesive.

Place insulation boards in a running bond pattern on the wall with the long dimension horizontal. Start by inserting the lower edge of the boards inside the starter track at the base of the wall until they contact the bottom of the track. Apply light pressure when placing the boards. After boards have been in place for 5-10 minutes use a straight edge to lightly press the boards inward and to keep board joints flush, as post expansion of the adhesive may force boards slightly outward.

b. Cementitious Adhesive (Sto BTS Plus or Sto BTS Xtra): apply adhesive to the back of the insulation board with the proper size (1/2 x ½ x 2 inch [13 x 13 x 51 mm]) stainless steel notched trowel. Apply uniform ribbons of adhesive parallel with the SHORT dimension of the board so that when boards are placed on the wall the ribbons will be VERTICAL. Apply adhesive uniformly so ribbons of adhesive do not converge. Immediately place insulation boards in a running bond pattern on the wall with the long dimension horizontal. Start by inserting the lower edge of the boards

inside the starter track at the base of the wall until they contact the bottom of the track. Apply firm pressure over the entire surface of the boards to ensure uniform contact of adhesive. IMPORTANT: do not delay installation once adhesive is applied. If adhesive "skins" remove it and apply fresh adhesive.

4. Bridge sheathing joints by a minimum of 6 inches (152 mm). Interlock inside and outside corners.
5. Butt all board joints tightly together to eliminate any thermal breaks. Care must be taken to prevent any adhesive from getting between the joints of the boards.
6. Cut insulation board in an L-shaped pattern to fit around openings. Do not align board joints with corners of openings.
7. Check for satisfactory contact of the insulation board with the substrate. If any boards have loose areas use the spray foam adhesive dispensing pistol to create a hole through the board and inject adhesive to attach the loose area. Allow the adhesive to expand to the outer face of the board while withdrawing the pistol. Cut excess adhesive flush with the surface of the insulation. Do not use nails, screws, or any other type of non-thermal mechanical fastener.

E. Slivering and Rasping of Insulation Board Surface

1. Make sure insulation boards are fully adhered to the substrate before proceeding to steps 3.04 E2 and 3.04 E3 below.
2. Fill any open joints in the insulation board layer with slivers of insulation or the spray foam adhesive.
3. Rasp the insulation board surface to achieve a smooth, even surface and to remove any ultraviolet ray damage.

F. Trim, Reveals and Projecting Aesthetic Features

NOTE: Reveals/aesthetic grooves may be designed into the system to accommodate workability on multi-level buildings or lengthy wall sections.

1. Attach features and trim where designated on drawings with adhesive to a base layer of insulation board or to the coated sheathing surface. Fill any gaps between the trim and base layer of insulation with spray foam adhesive and rasp flush with the trim surface. Slope the top surface of all trim/features minimum 1:2 (27°) and the bottom of all horizontal reveals minimum 1:2 (27°).
2. Cut reveals/aesthetic grooves with a hot-knife, router or groove-tool in locations indicated on drawings.
3. Offset reveals/aesthetic grooves minimum 3 inches (75 mm) from insulation board joints.
4. Do not locate reveals/aesthetic grooves at high stress areas.
5. Ensure minimum ¾ inch (19 mm) thickness of insulation board at the bottom of the reveals/aesthetic grooves.

G. Completion of Backwrapping

1. Complete the backwrapping procedure by applying base coat to exposed edges of insulation board and approximately 4 inches (100 mm) onto the face of the insulation board. Pull mesh tight around the board and embed it in the base coat with a stainless steel trowel. Use a corner trowel for clean, straight lines. Smooth any wrinkles or gaps in the mesh.

H. Accessory Installation

1. Corner Bead: cut the corner bead accessory to proper length as needed. Use full pieces wherever possible and avoid using short filler pieces. Offset accessory butt joints from substrate joints. Apply base coat with a stainless steel trowel to an approximate thickness of 1/8 inch (3 mm) to the outside corner area that will receive the accessory. Immediately place the accessory directly into the wet base coat material. Do not slide into place. Press the accessory into place. A corner trowel is best for this purpose. Embed and completely cover the mesh and PVC by troweling from the corner to the edge of the mesh so that no mesh or PVC color is visible. Avoid excess build-up of base coat and feather along mesh edges. Adjoin separate pieces by abutting PVC to PVC and overlapping the mesh "tail" from one piece onto the next piece. Fully embed the accessory and mesh "tail" in base coat material. When installing field mesh reinforcement overlap accessory mesh and PVC. Remove any excess base coat from the outside corner.

NOTE: Install the corner bead accessory prior to the application of field mesh. If installing a multi-layer mesh system such as StoTherm ci high impact systems with Sto Armor Mat or Sto Armor Mat XX, install the corner bead accessory over the first layer of mesh and before the final layer of mesh is installed.

For additional reinforcement at the corner the field mesh (paragraph 3.4.2 I5 below) may be wrapped around the corner and extend a minimum of 6 inches (152 mm) in one or both directions.

2. Drip Edge: install the drip edge accessory prior to application of field mesh (paragraph 3.4.2 I5 below). Install with arrow on mesh pointing UP. Cut the accessory to proper length as needed. Use full pieces wherever possible and avoid using short filler pieces. Offset accessory butt joints from substrate joints. Apply base coat with a stainless steel trowel to an approximate thickness of 1/8 inch (3 mm) to the area that will receive the accessory. Immediately place the accessory directly into the wet base coat material and press into place. Do not slide into place. Embed and completely cover the mesh and PVC by troweling from the drip edge screed rail to the edge of the mesh. Avoid excess build-up of base coat, feather along mesh edges, and remove any excess base coat from the drip edge nosing. Abut adjoining pieces and install as described above. When installing field mesh reinforcement overlap accessory mesh 4 inches (10 cm) on both vertical and horizontal faces so the PVC is overlapped, and remove any excess base coat from the drip edge nosing. On vertical and horizontal faces of the accessory install finish to the drip edge lines and remove any protruding finish from the drip edge nosing.

I. Base Coat and Reinforcing Mesh Application

1. Ensure the insulation board is firmly adhered and free of surface contamination or UV degradation, and is thoroughly rasped before commencing the base coat application.

2. Apply minimum 9x12 inch (225x300 mm) diagonal strips of detail mesh at corners of windows, doors, and all penetrations through the system. Embed the strips in wet base coat and trowel from the center to the edges of the mesh to avoid wrinkles.

3. Apply detail mesh at trim, reveals and projecting architectural features. Embed the mesh in the wet base coat. Trowel from the base of reveals to the edges of the mesh.

4. Ultra-High impact mesh application (recommended to a minimum height of 6'-0" [1.8 m] above finished grade at all areas accessible to pedestrian traffic and other areas exposed to abnormal stress or impact, and where indicated on contract drawings): apply base coat over the insulation board with a stainless steel trowel to a uniform thickness of approximately 1/8 inch (3 mm). Work horizontally or vertically in strips of 40 inches (1016 mm), and immediately embed the mesh into the wet base coat by troweling from the

center to the edge of the mesh. Butt ultra-high impact mesh at seams. Allow the base coat to dry.

5. Standard mesh application: Apply base coat over the insulation board, including areas with Ultra-High impact mesh, with a stainless steel trowel to a uniform thickness of approximately ⅛ inch (3 mm). Work horizontally or vertically in strips of 40 inches (1016mm), and immediately embed the mesh into the wet base coat by troweling from the center to the edge of the mesh. Overlap mesh not less than 2-½ inches (64 mm) at mesh seams and at overlaps of detail mesh. Feather seams and edges. Double wrap all inside and outside corners with minimum 6 inch (152 mm) overlap in each direction (optional if corner bead accessory is used – see NOTE to paragraph 3.4.2 H1 above).Avoid wrinkles in the mesh. The mesh must be fully embedded so that no mesh color shows through the base coat when it is dry. Re-skim with additional base coat if mesh color is visible.
6. Sloped Surfaces: for trim, reveals, aesthetic bands, cornice profiles, sills or other architectural features that project beyond the vertical wall plane more than 2 inches (51 mm) apply waterproof base coat with a stainless steel trowel to the sloped surface and minimum four inches (100 mm) above and below it. Embed standard mesh or detail mesh in the waterproof base coat and overlap mesh seams a minimum of 2-½ inches (65 mm).
7. Allow base coat to thoroughly dry before applying primer or finish.

NOTE: *All trim and projecting architectural features must have a minimum 1:2 [27°] slope along their top surface. All horizontal reveals must have a minimum 1:2 [27°] slope along their bottom surface. Increase slope for northern climates to prevent accumulation of ice/snow and water on surface. Where trim/feature or bottom surface of reveal projects more than 2 inches (51 mm) from the face of the EIFS wall plane, protect the weather exposed sloped surface with waterproof base coat.* ***Maximum insulation board thickness is 12 inches (305 mm), which includes trim and architectural features.*** *Periodic inspections and increased maintenance may be required to maintain surface integrity of the EIFS on sloped, weather exposed surfaces. Limit projecting features to easily accessible areas and limit total area to facilitate maintenance and minimize maintenance burden. Refer to Sto Details.*

Do not use the EIFS on weather exposed projecting ledges, sills, or other projecting features unless supported by framing or other structural support and protected with metal coping or flashing. Refer to Sto Detail 10.61.

J. Primer Application

NOTE: *The primer is an optional component [except for some specialty finishes] which reduces surface water absorption of the base coat and enhances finish color, texture, and coverage.*

1. Ensure the base coat surface is free of surface contamination before commencing the primer application.
2. Apply primer evenly with brush, roller or proper spray equipment over the clean, dry base coat and allow to dry thoroughly before applying finish.

K. Finish Coat Application

1. Ensure the base coat surface or primed base coat is free of surface contamination before commencing the finish application.
2. Apply finish directly over the base coat or primed base coat when dry. Apply finish by spray or stainless steel trowel, depending on the finish specified. Follow these general rules for application of finish:
   a. Avoid application in direct sunlight.
   b. Apply finish in a continuous application, and work to an architectural break in the wall.
   c. Weather conditions affect application and drying time. Hot or dry conditions limit working time and accelerate drying. Adjustments in the scheduling of work may be required to achieve desired results. Cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing. Adjust work schedule and provide protection.
   d. Do not install separate batches of finish side-by-side.
   e. Do not apply finish into or over sealant joints. Apply finish to outside face of wall only.
   f. Do not apply finish over irregular or unprepared surfaces, or surfaces not in compliance with the requirements of the project specifications.

3.5 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them

B. Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry

3.6 CLEANING, REPAIR AND MAINTENANCE

A. Clean and maintain the EIFS for a fresh appearance and to prevent water entry into and behind the system. Repair cracks, impact damage, spalls or delamination promptly.

B. Maintain adjacent components of construction such as sealants, windows, doors, and flashing, to prevent water entry into or behind the EIFS and anywhere into the wall assembly

C. Refer to Sto reStore Repair and Maintenance Guide (reStore Program) for detailed information on restoration – cleaning, repairs, recoating, resurfacing and refinishing, or re-cladding

ATTENTION

Sto products are intended for use by qualified professional contractors, not consumers, as a component of a larger construction assembly as specified by a qualified design professional, general contractor or builder. They should be installed in accordance with those specifications and Sto's instructions. Sto Corp. disclaims all, and assumes no, liability for on-site inspections, for its products applied improperly, or by unqualified persons or entities, or as part of an improperly designed or constructed building, for the nonperformance of adjacent building components or assemblies, or for other construction activities beyond Sto's control. Improper use of Sto products or use as part of an improperly designed or constructed larger assembly or building may result in serious damage to Sto products, and to the structure of the building or its components. STO CORP. DISCLAIMS ALL WARRANTIES EXPRESS OR IMPLIED EXCEPT FOR EXPLICIT LIMITED WRITTEN WARRANTIES ISSUED TO AND ACCEPTED BY BUILDING OWNERS IN ACCORDANCE WITH STO'S WARRANTY PROGRAMS WHICH ARE SUBJECT TO CHANGE FROM TIME TO TIME. For the fullest, most current information on proper application, clean-up, mixing and other specifications and warranties, cautions and disclaimers, please refer to the Sto Corp. website, www.stocorp.com.

SECTION 072500 - SPRAYED-ON AND TROWELED FIREPROOFING

1. Summary:

   A. This Section includes the following:

      1. New exposed sprayed-on (1) hour fireproofing on the metal deck and steel framing that supports the deck on the ceiling of the Penthouse. Provide UL listing # and meet the criteria of that UL listing.
      2. New concealed trowelled-on (1) hour fireproofing on the steel framing that supports the raised floor in the Penthouse. Provide UL listing # and meet the criteria of that UL listing.
      3. Repair of existing fireproofing on existing building elements, per A.1 and A.2, where required for missing fireproofing or fireproofing disturbed during construction (show a $10,000 Allowance for this in the Base Bid)

2. Definitions:

   A. Concealed sprayed-on fireproofing refers to applications where sprayed-on materials are applied to surfaces which will be concealed from view behind other construction when the Work is completed.

   B. Exposed sprayed-on fireproofing refers to applications where sprayed-on materials are applied to surfaces which are exposed to view when the Work is completed.

3. Related Sections

   (not used)

4. Submittals:

   A. Product data for each sprayed-on fireproofing product indicated.

   B. Test reports containing the following information:

      1. Test results from an independent testing laboratory indicating compliance of sprayed-on fireproofing products with performance requirements indicated, including asbestos content where applicable.
      2. Test results of in-place performance as required under Part 3 of this section for field quality control.

   C. Certificates from fireproofing manufacturer, for each fireproofing product required, indicating that:

      1. Primers applied to steel in shop or field are compatible with sprayed-on fireproofing and will not impair its performance under fire exposure for applications indicated, as proved by ASTM E 119 test. Include test and other data as evidence.
      2. Each fireproofing product required complies with specified product requirements and is suitable for the use indicated.

5. Quality Assurance:

   A. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying the progress of the Work.

B. Single Source Responsibility: Obtain sprayed-on fireproofing materials from a single manufacturer for each different product required.

C. Fire Performance Characteristics: Provide materials and construction which are identical to those tested for the following fire performance characteristics, per test method indicated, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction.

1. Fire Resistance Ratings: As indicated by reference to design designation in UL "Fire Resistance Directory" for fire-resistance-rated assemblies in which sprayed-on fireproofing serves as direct-applied protection, tested per ASTM E 119.
2. Surface Burning Characteristics: As indicated for each sprayed-on fireproofing product required, tested per ASTM E 84 and listed in UL "Building Materials Directory".

D. Asbestos Content: For products containing lightweight aggregates or mineral fibers, provide products that comply with 29 CFR 1926.58 (OSHA regulations for maximum allowable asbestos content) by containing less than 0.10 percent by weight of asbestos and for which it can be demonstrated that, under reasonably foreseeable jobsite conditions, will not release asbestos fibers in excess of 0.1 fibers per cubic centimeter.

6. Delivery, Storage, and Handling:

A. Deliver products to project site in original, unopened packages with manufacturers' labels identifying products legible and intact. Include on labels names of products and manufacturers, date of manufacture and shelf life, where applicable. Also include UL labels for fire-resistance ratings applicable to project.

B. Use materials with limited shelf life within period indicated. Remove from project site and discard any materials whose shelf life has expired.

C. Store materials inside, under cover, above ground and in a manner to keep them dry until ready to use. Remove from project site and discard any materials that have been exposed to moisture or have otherwise deteriorated.

7. Project Conditions:

A. Environmental Conditions: Do not install sprayed-on fireproofing when ambient or substrate temperatures are 40 deg F (4.4 deg C) and falling, unless temporary protection and heat can be provided to maintain temperatures of both at or above this temperature level for 24 hours before, during, and for 24 hours after application of sprayed fireproofing.

B. Ventilation: Ventilate spray fireproofing by means of natural or, where this is inadequate, of forced air circulation during and after application until it dries thoroughly.

8. Sequencing:

A. Sequence and coordinate application of sprayed-on fireproofing with other, related work specified in other sections to comply with the following requirements:

1. Provide temporary enclosures to prevent deterioration of sprayed-on fireproofing for interior applications due to exposure to unfavorable environmental conditions.
2. Avoid unnecessary exposure of sprayed-on fireproofing to abrasion and other damage

likely to occur during construction operations subsequent to its application.
3. Do not apply fireproofing to metal roof decking substrates until application of roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
4. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, tested, and corrections made to any defective fireproofing.

9. Concealed Sprayed-On Fireproofing Materials:

A. General: For concealed applications of sprayed-on fireproofing provide manufacturer's standard products conforming with existing fire ratings, and complying with requirements indicated below for material composition and physical properties representative of installed products.

B. Material Composition: Either of the following products:

1. Cementitious Fireproofing: Factory-mixed dry formulation of inorganic binders and lightweight mineral aggregates mixed with water at project site to form a slurry for pumping and for dispersal by compressed air introduced at spray nozzle.
2. Mineral Fiber Fireproofing: Factory-mixed dry formulation of inorganic binders, mineral fibers, fillers and additives for sprayed-on application by conveying dry mixture by low pressure air through hose and mixing it with water at spray nozzle.

C. Physical Properties: Minimum values, unless otherwise indicated, measured per standard test methods referenced with each property, as follows:

1. Bond Strength: 80 lbf per sq. ft. per ASTM E 736.
2. Compressive Strength: 3.47 lbf per sq. inch per ASTM E 761.
3. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
4. Deflection: No cracking, spalling, delamination or the like per ASTM E 759.
5. Effect of Impact on Bonding: No cracking, spalling, delamination or the like per ASTM E 760.
6. Air Erosion: Maximum weight loss of 0.025 grams per sq. ft. per ASTM E 859.
7. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E 605.
8. Dry Density: Values for average and individual densities as required for fire-resistance rating indicated, per ASTM E 605, but not less than the following:

a. For cementitious fireproofing: 14 lb per cu. ft.
b. For mineral fiber fireproofing: 13 lb per cu. ft.

9. Hardness: 0.50 inch maximum penetration per ASTM C 569.
10. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 10 and 0, respectively.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Cementitious Fireproofing:
2. "Monokote"; Grace Construction Products Div., W.R. Grace & Co.
3. Mineral Fiber Fireproofing:
4. "SprayDon Standard J"; American Energy Products Corp.
5. "Cafco Blaze-Shield"; Isolatek International Corp.
6. "Cafco Deck-Shield"; Isolatek International Corp.

10. Auxiliary Fireproofing Materials:

A. General: Provide auxiliary fireproofing materials that are compatible with sprayed-on fireproofing products and substrates, are approved for use indicated by manufacturer of sprayed-on fireproofing, and are approved by UL or other testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance rated designs indicated.

11. Examination:

A. Examine substrates, with Installer present, to determine if they are in satisfactory condition to receive sprayed-on fireproofing. A substrate is in satisfactory condition if it complies with the following:

1. Substrate complies with requirements of the section in which the substrate and related work is specified and is free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt or other foreign substances capable of impairing bond of fireproofing with substrate under conditions of normal use or fire exposure.

2. Objects which will penetrate fireproofing, including clips, hangers, support sleeves and similar items have been securely attached to substrates.
3. Substrates are not obstructed by ducts, piping, equipment and other suspended construction that could interfere with application of fireproofing.

B. For steel, sheet metal ducts and other substrates suspected of being coated with oil, rolling compounds or other substances not readily identifiable but potentially capable of impairing bond, conduct tests recommended by fireproofing manufacturer to determine their presence and effect on adhesion of fireproofing.

C. Do not proceed with installation of fireproofing until unsatisfactory conditions have been corrected.

12. Preparation:
A. Clean substrates of substances which could impair bond of fireproofing, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.

B. Prime substrates where recommended by fireproofing manufacturer, except where compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

C. For exposed sprayed-on fireproofing applications repair substrates to remove any surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids which would telegraph through.

D. Cover other work which might be damaged by fall-out or overspray of fireproofing materials during application. Provide temporary enclosure as required to confine spraying operations, protect the environment, and to ensure adequate ambient conditions for temperature and ventilation.

13. Installation, General:

A. General: Comply with fireproofing manufacturer's instructions for mixing materials, for application procedures and for types of equipment used to convey and spray-on fireproofing materials; as applicable to the particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Coat substrates with adhesive prior to application of fireproofing where required to achieve

fire-resistance rating or recommended by fireproofing manufacturer for material and application indicated.

C. Extend fireproofing full thickness over entire area of each substrate to be protected. Unless otherwise recommended by fireproofing manufacturer, install body of fireproof covering in a single course.

D. Apply fireproofing in thicknesses and densities indicated but not less than that required to achieve fire resistance ratings designated for each condition, unless greater thicknesses and densities are indicated.

1. For steel beams and bracing provide a thickness of not less than 1".
2. For metal floor or roof decks provide a thickness of not less than 1/2".

E. Apply fireproofing materials by sprayed-on method to maximum extent possible. Use smallest pump available for sprayed work. Following spraying operation in each area, complete the coverage by trowel application or other placement method acceptable to manufacturer.

14. Field Quality Control:

A. Testing Laboratory: Owner will employ and pay a qualified independent testing laboratory to perform field quality control testing.

15. Cleaning, Repair, and Protection:

A. Cleaning: Immediately upon completion of spraying operations in each containable area of project, remove over-spray and fall-out of materials from surfaces of other work and clean exposed surfaces to remove evidence of soiling.

B. Cure exposed cementitious fireproofing materials in compliance with fireproofing manufacturers recommendations to prevent premature drying.

C. Protect fireproofing according to advice of fireproofing manufacturer and Installer from damage resulting from construction operations or other causes so that fireproofing will be without damage or deterioration at time of Substantial Completion.

D. Coordinate installation of fireproofing with other work in order to minimize the need for other trades to cut or remove fireproofing. As other trades successively complete installation of their work, maintain protection of structure afforded by fireproofing by patching any areas which have been removed or damaged prior to concealment of fireproofing by other work.

E. Repair or replace work which has not been successfully protected.

END OF SECTION 072500

07521-ROOFING ON CONCRETE DECK

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. Preparation of Substrate to Receive Roofing Materials

B. Roof Insulation Application to Prepared Substrate

C. Roof Membrane Application

D. Roof Flashing Application

E. Incorporation of Sheet Metal Flashing Components and Roofing Accessories into the Roof System

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Sheet Metal Flashing and Trim

B. Sheet Metal Roofing Specialties

1.03 RELATED SECTIONS

A. Section [----] - Rough Carpentry

B. Section [----] - Roof Decks

C. Section [----] - Sheet Metal Flashing and Trim

D. Section [----] - Sheet Metal Roofing Specialties

1.04 REFERENCE STANDARDS

References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout these specifications.

ASTM American Society for Testing and Materials
Philadelphia, PA

FM Factory Mutual Engineering and Research
Norwood, MA

NRCA	National Roofing Contractors Association Rosemont, IL
OSHA	Occupational Safety and Health Administration Washington, DC
SMACNA	Sheet Metal and Air Conditioning Contractors National Association Chantilly, VA
UL	Underwriters Laboratories Northbrook, IL

1.05 DESCRIPTION OF WORK

The basic work descriptions required in this specification are referenced below.

Project Type: New Construction Specification #: 2030 IT

Deck: Structural concrete Slope: 0 - 1/4 inch

Substrate Preparation: Prime with PA-917 LS Primer at a rate of 1 gallon per 100 to 300 square feet.

Temporary Roof: Irex 40, torch applied.

Insulation-bottom layer: Paratherm by Siplast, having a thickness of 5.2 inches, applied in Para-Stik Insulation Adhesive.

Tapered Insulation: Tapered Paratherm system by Siplast, providing for a roof slope of 1/8 inch, applied in Para-Stik Insulation Adhesive.

Insulation - top layer: DensDeck Prime supplied by Siplast, having a thickness of 1/2 inch, applied in Para-Stik Insulation Adhesive.

Roof System: Paradiene 20 TG, torch applied;

Paradiene 30 FR TG, torch applied.

Flashing System: Paraflex 531 Flashing System

Protective Walkways: Paratread, applied in PA 1021 cement

1.06 SUBMITTALS

All submittals which do not conform to the following requirements will be rejected.

A. Submittals Prior to Contract Award:

1. Letter from the proposed primary roofing manufacturer confirming that the bidder is an acceptable Contractor authorized to install the proposed system.

2. Letter from the primary roofing manufacturer stating that the proposed application will comply with the manufacturer's requirements in order to qualify the project for the specified guarantee.

B. Submittals Prior to Project Close-out:

1. Manufacturer's printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration addition policies, temporary repairs, and leak call procedures.

1.07 QUALITY ASSURANCE

A. Acceptable Products: Primary roofing products, including each type of sheet, all manufactured in the United States, shall be supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. The primary roofing products shall have maintained a consistent composition for a minimum of five years.

B. Product Quality Assurance Program: Primary roofing materials shall be manufactured under a quality management system that is monitored regularly by a third party auditor under the ISO 9001 audit process. A certificate of analysis for reporting/confirming the tested values of the actual material being supplied for the project will be required prior to project close-out.

C. Agency Approvals: The proposed roof system shall conform to the following requirements. No other testing agency approvals will be accepted.

1. Underwriters Laboratories Class A acceptance of the proposed roofing system (including mopping asphalt or cold adhesive) without additional requirements for gravel or coatings.

2. Evidence by an accredited independent testing agency or agencies that the roof configuration meets a maximum design windload pressure of - 292.5 psf or greater at the field, perimeter, and corner zones of the roof.

3. The roof membrane system shall meet the approval requirements of the U.S. EPA Energy Star program.

D. Acceptable Contractor: Contractor shall have a minimum of 2 years experience in successfully installing the same or similar roofing materials and be certified in writing by the roofing materials manufacturer to install the primary roofing products.

E. Scope of Work: The work to be performed under this specification shall include but is not limited to the following: Attend necessary job meetings and furnish competent and full time supervision, experienced roof mechanics, all materials, tools, and equipment necessary to complete, in an acceptable manner, the roof installation in accordance with this specification. Comply with the latest written application instructions of the manufacturer of the primary roofing products. In addition, application practice shall comply with requirements and recommendations contained in the latest edition of the Handbook of Accepted Roofing Knowledge (HARK) as published by the National Roofing Contractor's Association, amended to include the acceptance of a phased roof system installation.

F. Local Regulations: Conform to regulations of public agencies, including any specific requirements of the city and/or state of jurisdiction.

G. Manufacturer Requirements: Ensure that the primary roofing materials manufacturer provides direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conducts a final inspection upon successful completion of the project.

1.08 PRODUCT DELIVERY STORAGE AND HANDLING

A. Delivery: Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.

B. Storage: Store materials out of direct exposure to the elements on pallets placed over clean, flat and dry surfaces. Storage of pallets over dirt, grass-covered ground or newly placed concrete may result in upward moisture transpiration and contamination of product. Store rolls of roofing on end. For roof-top storage, avoid overloading of deck and building structure. Factory packaging is not intended for job site protection. Slit factory packaging immediately upon arrival at the job site to prevent build-up of condensation and cover materials using a breathable cover such as a canvas. Polyethylene or other non-breathable plastic coverings shall not be used. Store flammable or temperature sensitive materials away from open flame, ignition sources or excessive heat.

C. Handling: Handle all materials in such a manner as to preclude damage and contamination with moisture or foreign matter. Handle rolled goods to prevent damage to edges or ends.

D. Damaged Material: Any materials that are found to be damaged or stored in any manner other than stated above will be automatically rejected, removed and replaced at the Contractor's expense.

1.09 PROJECT/SITE CONDITIONS

A. Requirements Prior to Job Start

1. Notification: Give a minimum of 5 days notice to the Owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.

2. Permits: Obtain all permits required by local agencies and pay all fees which may be required for the performance of the work.

3. Safety: Familiarize every member of the application crew with all fire and safety regulations recommended by OSHA, NRCA and other industry or local governmental groups.

B. Environmental Requirements

1. Precipitation: Do not apply roofing materials during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.

C. Protection Requirements

1. Membrane Protection: Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.

2. Torch Safety: Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.

3. Limited Access: Prevent access by the public to materials, tools and equipment during the course of the project.

4. Debris Removal: Remove all debris daily from the project site and take to a legal dumping area authorized to receive such materials.

5. Site Condition: Complete, to the owner's satisfaction, all job site clean-up including building interior, exterior and landscaping where affected by the construction.

1.10 GUARANTEE/WARRANTY

A. Roof Membrane/System Guarantee: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with the manufacturer's 20 year labor and materials guarantee covering the rigid insulation, insulation adhesive and roof membrane/flashing system. The guarantee shall be a term type, without deductibles or limitations on coverage amount, and shall be issued at no additional cost to the Owner.

> Siplast 20 year Roof Membrane/System Guarantee

PART 2 PRODUCTS

2.01 ROOFING SYSTEM ASSEMBLY/PRODUCTS

A. Temporary Roof Ply Sheet

1. Torchable Modified Bitumen Ply Sheet:

> Irex 40 by Siplast; Irving, TX

B. Rigid Roof Insulation: Roof insulation shall be UL and FM approved. Insulation shall be approved in writing by the insulation manufacturer for intended use and for use with the specified roof assembly. Maintain a maximum panel size of 4 feet by 4 feet where polyisocyanurate insulation is specified to be installed in insulation adhesive.

1. INSULATION - MULTIPLE LAYER. Install insulation panels in an application of the specified insulation adhesive in strict accordance with the requirements of the insulation adhesive manufacturer. Insulation panels installed in adhesive shall have a maximum

panel size of 4 feet by 4 feet with a combined thickness of 5.2 inches providing for a long term thermal resistance of R 30.

> Paratherm by Siplast; Irving, TX.

2. Polyisocyanurate Tapered Roof Insulation: Tapered panels and standard fill panels composed of a closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber facers, in full compliance with ASTM C 1289, Type II, Class 1, Grade 2. The tapered system shall provide for a roof slope of 1/4 inch per foot. Acceptable types are as follows.

> Tapered Paratherm by Siplast; Irving, TX

2. Gypsum Sheathing Panel: A panel composed of a gypsum based, non-structural water resistant core material integrally bonded with fiberglass mats on both sides having a nominal thickness of 1/4 inch. The panel surface shall be factory primed with a non-asphaltic primer. Acceptable types are as follows:

> DensDeck Prime Gypsum Roof Board, by Georgia Pacific Corporation; Atlanta, GA

2.02 DESCRIPTION OF SYSTEMS

A. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend and coated one side with a torch grade SBS bitumen blend adhesive layer. The adhesive layer shall be manufactured using a process that embosses the surface with a grooved pattern to provide optimum burn-off of the plastic film and to maximize application rates. The cross sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system.

> Siplast Paradiene 20 TG/30 FR TG BW torchable roof system

1. Modified Bitumen Base and Stripping Ply

a) Thickness (avg): 114 mils (2.9 mm) (ASTM D 5147)
b) Thickness (min): 110 mils (2.8 mm) (ASTM D 5147)
c) Weight (min per 100 ft² of coverage): 76 lb (3.7 kg/m²)
d) Maximum filler content in elastomeric blend: 35% by weight
e) Low temperature flexibility @ -15ºF (-26ºC): PASS (ASTM D 5147)
f) Peak Load (avg) @ 73ºF (23ºC): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
g) Peak Load (avg) @ 0ºF (-18ºC): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
h) Ultimate Elongation (avg.) @ 73ºF (23ºC): 50% (ASTM D 5147)
i) Dimensional Stability (max): 0.1% (ASTM D 5147)
j) Compound Stability (min): 250ºF (121ºC) (ASTM D 5147)

k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
l) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria

> Siplast Paradiene 20 - torchable grade

2. Modified Bitumen Finish Ply

a) Thickness (avg): 138 mils (3.5 mm) (ASTM D 5147)
b) Thickness at selvage (coating thickness) (avg): 118 mils (3.0 mm) (ASTM D 5147)
c) Thickness at selvage (coating thickness) (min): 114 mils (2.9 mm) (ASTM D 5147)
d) Weight (min per 100 ft² of coverage): 112 lb (5.4 kg/m²)
e) Maximum filler content in elastomeric blend: 35% by weight
f) Low temperature flexibility @ -15ºF (-26ºC): PASS (ASTM D 5147)
g) Peak Load (avg) @ 73ºF (23ºC): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
h) Peak Load (avg) @ 0ºF (-18ºC): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
i) Ultimate Elongation (avg.) @ 73ºF (23ºC): 55% (ASTM D 5147)
j) Dimensional Stability (max): 0.1% (ASTM D 5147)
k) Compound Stability (min): 250ºF (121º C) (ASTM D 5147)
l) Granule Embedment (max loss): 2.0 grams per sample (ASTM D 5147)
m) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
n) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
o) Surfacing: ceramic granules specially treated for cool roof applications.

> Siplast Paradiene 30 FR TG BW

B. Flashing Membrane Assembly: A fluid-applied flashing membrane consisting of fluid-applied silane terminated polymer liquid reinforced with polyester fleece. A prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt sheet shall be used for flashing reinforcement and stripping. The back of the modified bitumen sheet shall be coated with factory applied polymer modified asphalt self-adhesive coating covered with a removable film. The top surface of the modified bitumen ply sheet shall be coated with a white acrylic coating to serve as a bleed-blocker.

> Siplast Paraflex 531 Liquid Flashing System

1. Self-Adhesive Modified Bitumen Stripping Ply and Flashing Reinforcing Sheet

a) Thickness (avg): 102 mils (2.6 mm) (ASTM D 5147)
b) Thickness (min): 98 mils (2.5 mm) (ASTM D 5147)
c) Weight (min per 100 ft² of coverage): 69 lb (3.4 kg/m²)
d) Maximum filler content in elastomeric blend: 35% by weight
e) Low temperature flexibility @ -15º F (-26º C) - PASS (ASTM D 5147)
f) Peak Load (avg) @ 73ºF (23ºC): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
g) Peak Load (avg) @ 0ºF (-18ºC): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
h) Ultimate Elongation (avg.) @ 73ºF (23ºC): 50% (ASTM D 5147)
i) Dimensional Stability (max): 0.1% (ASTM D 5147)
j) Compound Stability (min - sheet): 250ºF (121ºC) (ASTM D 5147)
k) Compound Stability (min – adhesive coating): 212ºF (100ºC) (ASTM D 5147)
l) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
m) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria

n) Back Surfacing: polyolefin release film
o) Top Surfacing: factory applied acrylic coating

> Pro Base SA by Siplast; Irving, TX

2. Resin for Flashing Applications: A flexible, single component, moisture-cured liquid membrane using silane terminated polymer technology.

a) Thickness (avg): 90 mils (2.3 mm) at 0.31 kg/ft² (3.3 kg/m²) coverage rate (ASTM D5147, section 6).
b) Peak Load (avg) @ 73°F (23°C): 55 lbf/in (9.6 kN/m) (ASTM D5147 section 7)
c) Elongation at Peak Load (avg) @ 73°F: 35% (ASTM D5147, section 7)
d) Shore A Hardness (avg): 80 (ASTM D2240)
e) Water Absorption, Method I (24h @ 73°F): 0.8% (ASTM D570)
f) Water Absorption, Method II (48h @ 122°F): 1.2% (ASTM D570)
g) Low temperature flexibility @ -40° F (-40°C): PASS (ASTM D5147, section 12)
h) Dimensional Stability (max): 0.15% (ASTM D5147, section 11)
i) Tear Strength (avg): 60 lbf (0.4 kN) (ASTM D5147, section 8)
j) Water Vapor Transmission: 0.47 perms (ASTM E96)

> Paraflex 531 Liquid Flashing by Siplast; Irving, TX

3. Fleece for Flashing Membrane Reinforcement: A non-woven, 110 g/m², needle-punched polyester fabric reinforcement as supplied by the membrane system manufacturer.

> Pro Fleece by Siplast; Irving, TX

2.03 ROOFING ACCESSORIES

A. Roofing Adhesives

1. Insulation Adhesive: A single component, moisture cured, polyurethane foam adhesive, dispensed from a portable, pre-pressurized container used to adhere insulation panels to the substrate as well to other insulation panels.

> Para-Stik Insulation Adhesive by Siplast; Irving, TX

B. Bituminous Cutback Materials

1. Primer: An asphalt/solvent blend meeting ASTM D 41, South Coast Air Quality District and Ozone Transport Commission requirements.

> Siplast PA-917 LS Primer by Siplast; Irving, TX

2. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements.

> Siplast PA-1021 Plastic Cement by Siplast; Irving, TX

C. Sealant: A moisture-curing, self-levelling elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials. Acceptable types are as follows:

> Siplast PS-715NS Elastomeric Sealant by Siplast; Irving, TX
> Siplast PS 209 Elastomeric Sealant by Siplast; Irving, TX

D. Ceramic Granules: No. 11 grade specification ceramic granules of color scheme matching the granule surfacing of the finish ply.

E. Perlite Cant Strips: A cant strip composed of expanded volcanic minerals combined with waterproofing binders. The top surface shall be pre-treated with an asphalt based coating. The face of the cant shall have a nominal 4 inch dimension.

F. Fasteners

1. Flashing Reinforcing Sheet Fasteners for Wood/Plywood Substrates to Receive Flashing Coverage: Fasteners shall be approved by the manufacturer of the primary roofing products. Acceptable fasteners for specific substrate types are listed below.

a) Wood/Plywood Substrates

- A 12 gauge, spiral or annular threaded shank, zinc coated steel roofing fastener having a minimum 1 inch head.

> Square Cap by W.H. Maze Co.; Peru, IL
> 12 Gauge Simplex Nail by the Simplex Nail and Manufacturing Co., Americus, GA

G. Walktread: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface.

> Paratread Roof Protection Material by Siplast; Irving, TX

PART 3 EXECUTION

3.00 Approved Installers:

Company	**Contact**	**Email**	**Phone**
James A. Edgar Co., Inc.	Chris Carr	ccarr@jaeroofinginc.com	518-346-8896
Midstate Industries	Mike Lucey	michael@midstateltd.com	518-374-1461
J & A Roofing	Rick Peruso	rick@jaroofing.com	845-339-2020
Titan Roofing, Inc.	Ed Wells	ewells@titanroofing.com	518-235-1707

A pre-job conference with the Manufacturer is required prior to proceeding with this work.

3.01 PREPARATION

A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.

B. REMOVE ALL EXISTING:

1. Surface gravel

2. Roof membrane
3. Insulation
4. Base flashings only as needed for roofing installation.
5. Edge meta only as needed for roofing installation.
6. Flanged metal flashings only as needed for roofing installation.
7. Cants, wood blocking
8. Walkways
9. Non functional penetrations/curbs
10. Drain assemblies
11. Vapor retarder
12. Metal trim, counterflashing, etc. only as needed for roofing installation.

C. Priming: Prime concrete substrate and masonry surfaces with a uniform coating of the specified primer.

3.02 SUBSTRATE PREPARATION

A. Temporary Roof Application: Torch apply the ply sheets directly to the prepared substrate, lapping sides and ends a minimum of 3 inches. Apply the sheets free of wrinkles, creases or fishmouths and exert sufficient pressure on the roll during application to ensure the prevention of air pockets. Seal each penetration and termination using fiberglass tape and the specified plastic cement to ensure that the temporary roof configuration is completely water-tight.

B. Insulation: Install insulation panels with end joints offset; edges of the panels shall be in moderate contact without forcing applied in strict accordance with the insulation manufacturer's requirements and the following instructions. Where insulation is installed in two or more layers, stagger joints between layers. Maintain a maximum panel size of 4 feet by 4 feet for polyisocyanurate insulation applied in insulation adhesive.

1. Insulation - multiple layer: Install all layers in an application of the specified insulation adhesive in strict accordance with the requirements of the insulation adhesive supplier. Stagger the panel joints between insulation layers.

3.03 ROOF MEMBRANE INSTALLATION

A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet and/or insulation as a continuous operation.

B. Aesthetic Considerations: An aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this project. Make necessary preparations, utilize recommended application techniques, apply the specified materials including granules, and exercise care in ensuring that the finished application is acceptable to the Owner.

C. Priming: Prime metal and concrete and masonry surfaces with a uniform coating of the specified asphalt primer.

D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

E. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets.

1. Apply all layers of roofing perpendicular to the slope of the deck.

2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the torch applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.

3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the torch applicator. Stagger end laps of the finish ply a minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.

4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.

F. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot or the adhesive is soft, to ensure a monolithic surface color.

G. Preparation/Mixing Fluid-Applied Products: Prior to application, stir liquid materials for a minimum of 2 minutes using a spiral mixer or mixing paddle. To avoid aeration, do not use a spiral mixer unless the spiral section of the mixer can be fully contained in the liquid during the mixing process. Mix only enough product to ensure that it can be applied before pot life expires.

H. Water Cut-Off: At end of day's work, or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to the resumption of roofing.

3.04 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

A. Walktread: Cut the walktread into maximum 5 foot lengths and allow to relax until flat. Adhere the sheet using the specified plastic cement. Apply the specified cement in a 3/8 inch thickness to the back of the product in 5 inch by 5 inch spots in accordance with the pattern as supplied by the walktread manufacturer. Walk-in each sheet after application to ensure proper adhesion. Use a minimum spacing of 2 inches between sheets to allow for proper drainage.

B. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal flashings incorporated into the roof system.

3.05 FIELD QUALITY CONTROL AND INSPECTIONS

A. Site Condition: Leave all areas around job site free of debris, roofing materials, equipment and related items after completion of job.

B. Notification Of Completion: Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.

C. Final Inspection

1. Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.

D. Issuance Of The Guarantee: Complete all post installation procedures and meet the manufacturer's final endorsement for issuance of the specified guarantee.

SECTION 075202 ROOFING ON METAL DECK

PART 1 GENERAL

1.01 SECTION INCLUDES:

A. Preparation of Substrate to Receive Roofing Materials

B. Roof Insulation Application to Prepared Substrate

C. Roof Membrane Application

D. Roof Flashing Application

E. Incorporation of Sheet Metal Flashing Components and Roofing Accessories into the Roof System

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Sheet Metal Flashing and Trim

B. Sheet Metal Roofing Specialties

1.03 RELATED SECTIONS

A. Section [----] - Rough Carpentry

B. Section [----] – Roof Decks

C. Section [----] - Sheet Metal Flashing and Trim

D. Section [----] - Sheet Metal Roofing Specialties

1.04 REFERENCE STANDARDS

References in these specifications to standards, test methods and codes, are implied to mean the latest edition of each such standard adopted. The following is an abbreviated list of associations, institutions, and societies which may be used as references throughout this specification section.

ASTM	American Society for Testing and Materials Philadelphia, PA
FM	Factory Mutual Engineering and Research Norwood, MA
NRCA	National Roofing Contractors Association

Rosemont, IL

OSHA Occupational Safety and Health Administration
Washington, DC

SMACNA Sheet Metal and Air Conditioning Contractors National Association
Chantilly, VA

UL Underwriters Laboratories
Northbrook, IL

1.05 DESCRIPTION OF WORK

The basic work descriptions required in this specification are referenced below.

Project Type: New Construction

Deck: Metal Slope: Less than 1/4 inch

Gypsum Sheathing Panel: DensDeck Prime, having a thickness of 5/8 inch, mechanically attached.

Temporary roof: Irex 40, torch applied.

Insulation-bottom layer: Paratherm by Siplast, having a thickness of 5.2 inches, applied in Para-Stik Insulation Adhesive.

Tapered Insulation: Tapered Paratherm system by Siplast, providing for a roof slope of 1/8 inch, applied in Para-Stik Insulation Adhesive.

Insulation – top layer: DensDeck Prime by Georgia-Pacific, having a thickness of 1/2 inch, applied in Para-Stik Insulation Adhesive.

Roof System: Paradiene 20 TG, torch applied;

Paradiene 30 FR TG BW, torch applied.

Flashing System: Paraflex 531 Flashing System.

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1.06 SUBMITTALS

All submittals which do not conform to the following requirements will be rejected.

A. Submittals Prior to Contract Award:

1. Letter from the proposed primary roofing manufacturer confirming that the bidder is an acceptable Contractor authorized to install the proposed system.

2. Letter from the primary roofing manufacturer stating that the proposed application will comply with the manufacturer's requirements in order to qualify the project for the specified guarantee.

B. Submittals Prior to Project Close-out:

1. Certificate Of Analysis from the testing laboratory of the primary roofing materials manufacturer, confirming the physical and mechanical properties of the roofing membrane components. Testing shall be in accordance with the parameters published in ASTM D 5147 and ASTM D 7051 and indicate Quality Assurance/Quality Control data as required to meet the specified properties. A separate Certificate Of Analysis for each production run of material shall indicate the following information:

   a) Material type
   b) Lot number
   c) Production date
   d) Dimensions and Mass (indicate the lowest values recorded during the production run);
      - Roll length
      - Roll width
      - Selvage width
      - Total thickness
      - Thickness at selvage (coating thickness)
      - Weight
   e) Physical and Mechanical Properties;
      - Low temperature flexibility
      - Peak load
      - Ultimate Elongation
      - Dimensional stability
      - Compound Stability
      - Granule embedment
      - Resistance to thermal shock (foil faced products)

2. Manufacturer's printed recommendations for proper maintenance of the specified roof system including inspection frequencies, penetration addition policies, temporary repairs, and leak call procedures.

1.07 QUALITY ASSURANCE

A. Acceptable Products: Primary roofing products, including each type of sheet, all manufactured in the United States, shall be supplied by a single manufacturer which has been successfully producing the specified types of primary products for not less than 10 years. The primary roofing products shall have maintained a consistent composition for a minimum of five years.

B. Product Quality Assurance Program: Primary roofing materials shall be manufactured under a quality management system that is monitored regularly by a third party auditor under the ISO 9001 audit process. A certificate of analysis for reporting/confirming the tested values of the actual material being supplied for the project will be required prior to project close-out.

C. Agency Approvals: The proposed roof system shall conform to the following requirements. No other testing agency approvals will be accepted.

1. Underwriters Laboratories Class A acceptance of the proposed roofing system (including mopping asphalt or cold adhesive) without additional requirements for gravel or coatings.

D. Acceptable Contractor: Contractor shall have a minimum of 2 years experience in successfully installing the same or similar roofing materials and be certified in writing by the roofing materials manufacturer to install the primary roofing products.

E. Scope of Work: The work to be performed under this specification shall include but is not limited to the following: Attend necessary job meetings and furnish competent and full time supervision, experienced roof mechanics, all materials, tools, and equipment necessary to complete, in an acceptable manner, the roof installation in accordance with this specification. Comply with the latest written application instructions of the manufacturer of the primary roofing products. In addition, application practice shall comply with requirements and recommendations contained in the latest edition of the Handbook of Accepted Roofing Knowledge (HARK) as published by the National Roofing Contractor's Association, amended to include the acceptance of a phased roof system installation.

F. Local Regulations: Conform to regulations of public agencies, including any specific requirements of the city and/or state of jurisdiction.

G. Manufacturer Requirements: Ensure that the primary roofing materials manufacturer provides direct trained company personnel to attend necessary job meetings, perform periodic inspections as necessary, and conducts a final inspection upon successful completion of the project.

1.08 PRODUCT DELIVERY STORAGE AND HANDLING

A. Delivery: Deliver materials in the manufacturer's original sealed and labeled containers and in quantities required to allow continuity of application.

B. Storage: Store materials out of direct exposure to the elements on pallets placed over clean, flat and dry surfaces. Storage of pallets over dirt, grass-covered ground or newly placed concrete may result in upward moisture transpiration and contamination of product. Store rolls of roofing on end. For roof-top storage, avoid overloading of deck and building structure. Factory packaging is not intended for job site protection. Slit factory packaging immediately upon arrival at the job site to prevent build-up of condensation and cover materials using a breathable cover such as a canvas. Polyethylene or other non-breathable plastic coverings shall not be used. Store flammable or temperature sensitive materials away from open flame, ignition sources or excessive heat.

C. Handling: Handle all materials in such a manner as to preclude damage and contamination with moisture or foreign matter. Handle rolled goods to prevent damage to edges or ends.

D. Damaged Material: Any materials that are found to be damaged or stored in any manner other than stated above will be automatically rejected, removed and replaced at the Contractor's expense.

1.09 PROJECT/SITE CONDITIONS

A. Requirements Prior to Job Start

1. Notification: Give a minimum of 5 days notice to the Owner and manufacturer prior to commencing any work and notify both parties on a daily basis of any change in work schedule.

2. Permits: Obtain all permits required by local agencies and pay all fees which may be required for the performance of the work.

3. Safety: Familiarize every member of the application crew with all fire and safety regulations recommended by OSHA, NRCA and other industry or local governmental groups.

B. Environmental Requirements

1. Precipitation: Do not apply roofing materials during precipitation or in the event there is a probability of precipitation during application. Take adequate precautions to ensure that materials, applied roofing, and building interiors are protected from possible moisture damage or contamination.

2. Temperature Restrictions - self-adhesive sheets: The minimum required substrate temperature at point of application is 40°F (4°C). Maintain a minimum roof membrane material temperature above 60° F (16° C). In low temperature conditions, materials should be kept warm prior to application. In temperatures below 60° F (16° C) the specified tacky primer, required for vertical applications, should be considered to facilitate proper bonding of self-adhered membrane for horizontal applications. The minimum ambient temperature range at the time of tacky primer application is 45°F to 105°F (7°C - 40°C). Suspend application in situations where the self-adhered base ply cannot be kept at temperatures allowing for proper adhesion.

C. Protection Requirements

1. Membrane Protection: Provide protection against staining and mechanical damage for newly applied roofing and adjacent surfaces throughout this project.

2. Torch Safety: Crew members handling torches shall be trained by an Authorized Certified Roofing Torch Applicator (CERTA) Trainer, be certified according to CERTA torch safety guidelines as published by the National Roofing Contractor's Association (NRCA), and follow torch safety practices as required by the contractor's insurance carrier. Designate one person on each crew to perform a daily fire watch. The designated crew member shall watch for fires or smoldering materials on all areas during roof construction activity, and for the minimum period required by CERTA guidelines after roofing material application has been suspended for the day.

3. Limited Access: Prevent access by the public to materials, tools and equipment during the course of the project.

4. Debris Removal: Remove all debris daily from the project site and take to a legal dumping area authorized to receive such materials.

5. Site Condition: Complete, to the owner's satisfaction, all job site clean-up including building interior, exterior and landscaping where affected by the construction.

1.10 GUARANTEE/WARRANTY

A. Roof Membrane/System Guarantee: Upon successful completion of the project, and after all post installation procedures have been completed, furnish the Owner with the manufacturer's 20 year labor and materials guarantee covering the rigid insulation, insulation adhesive and roof membrane/flashing system. The guarantee shall be a term type, without deductibles or limitations on coverage amount, and shall be issued at no additional cost to the Owner.

> Siplast 20 year Roof Membrane/System Guarantee

PART 2 PRODUCTS

2.01 ROOFING SYSTEM ASSEMBLY/PRODUCTS

A. Gypsum Sheathing Panel

1. Gypsum Sheathing Panel: A panel composed of a gypsum based, non-structural water resistant core material integrally bonded with fiberglass mats on both sides having a nominal thickness of 5/8 inch. The panel surface shall be factory primed with a non-asphaltic primer. Acceptable types are as follows:

> DensDeck Prime Gypsum Roof Board, by Georgia Pacific Corporation; Atlanta, GA

B. Temporary Roof Ply Sheet

1. Torchable Modified Bitumen Ply Sheet: A fiberglass reinforced, specially modified asphalt coated sheet, having an minimum weight of 85 lb/sq.

> Siplast Irex 40

C Rigid Roof Insulation: Roof insulation shall be UL and FM approved. Insulation shall be approved in writing by the insulation manufacturer for intended use and for use with the specified roof assembly. Maintain a maximum panel size of 4 feet by 4 feet where polyisocyanurate insulation is specified to be installed in insulation adhesive.

1. Polyisocyanurate: A closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber reinforced organic facers, in full compliance with ASTM C 1289, Type II, Class 1, Grade 2 (20 psi). Panels shall have a nominal thickness of 2 inches. Acceptable types are as follows:

> Paratherm by Siplast; Irving, TX

2. Polyisocyanurate Tapered Roof Insulation: Tapered panels and standard fill panels composed of a closed cell, rigid polyisocyanurate foam core material, integrally laminated between glass fiber reinforced organic facers, in full compliance with ASTM C 1289, Type II, Class 1, Grade 2 (20 psi). The tapered system shall provide for a roof slope of 1/4 inch per foot. Acceptable types are as follows.

   > Tapered Paratherm by Siplast; Irving, TX

3. Gypsum Sheathing Panel: A panel composed of a gypsum based, non-structural water resistant core material integrally bonded with fiberglass mats on both sides having a nominal thickness of 1/2 inch. The panel surface shall be factory primed with a non-asphaltic primer. Acceptable types are as follows:

   > DensDeck Prime Gypsum Roof Board, by Georgia Pacific Corporation; Atlanta, GA

2.02 DESCRIPTION OF SYSTEMS

A. Roofing Membrane Assembly: A roof membrane assembly consisting of two plies of a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane, applied over a prepared substrate. Reinforcement mats shall be impregnated/saturated and coated each side with SBS modified bitumen blend and coated one side with a torch grade SBS bitumen blend adhesive layer. The adhesive layer shall be manufactured using a process that embosses the surface with a grooved pattern to provide optimum burn-off of the plastic film and to maximize application rates. The cross sectional area of the sheet material shall contain no oxidized or non-SBS modified bitumen. The roof system shall pass 500 cycles of ASTM D 5849 Resistance to Cyclic Joint Displacement (fatigue) at 14°F (-10°C). Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles. The roof system shall pass 200 cycles of ASTM D 5849 after heat conditioning performed in accordance with ASTM D 5147. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system.

   > Siplast Paradiene 20 TG/30 FR TG BW torchable roof system

   1. Modified Bitumen Base and Stripping Ply

      a) Thickness (avg): 114 mils (2.9 mm) (ASTM D 5147)
      b) Thickness (min): 110 mils (2.8 mm) (ASTM D 5147)
      c) Weight (min per 100 ft² of coverage): 76 lb (3.7 kg/m²)
      d) Maximum filler content in elastomeric blend: 35% by weight
      e) Low temperature flexibility @ -15ºF (-26ºC): PASS (ASTM D 5147)
      f) Peak Load (avg) @ 73ºF (23ºC): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
      g) Peak Load (avg) @ 0ºF (-18ºC): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
      h) Ultimate Elongation (avg.) @ 73ºF (23ºC): 50% (ASTM D 5147)
      i) Dimensional Stability (max): 0.1% (ASTM D 5147)
      j) Compound Stability (min): 250ºF (121ºC) (ASTM D 5147)

k) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
l) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria

> Siplast Paradiene 20 - torchable grade

2. Modified Bitumen Finish Ply

a) Thickness (avg): 138 mils (3.5 mm) (ASTM D 5147)
b) Thickness at selvage (coating thickness) (avg): 118 mils (3.0 mm) (ASTM D 5147)
c) Thickness at selvage (coating thickness) (min): 114 mils (2.9 mm) (ASTM D 5147)
d) Weight (min per 100 ft² of coverage): 96 lb (4.68 kg/m²)
e) Maximum filler content in elastomeric blend: 35% by weight
f) Low temperature flexibility @ -15ºF (-26ºC): PASS (ASTM D 5147)
g) Peak Load (avg) @ 73ºF (23ºC): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
h) Peak Load (avg) @ 0ºF (-18ºC): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
i) Ultimate Elongation (avg.) @ 73ºF (23ºC): 55% (ASTM D 5147)
j) Dimensional Stability (max): 0.1% (ASTM D 5147)
k) Compound Stability (min): 250ºF (121º C) (ASTM D 5147)
l) Granule Embedment (max loss): 2.0 grams per sample (ASTM D 5147)
m) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
n) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
o) Surfacing: ceramic granules specially treated for cool roof applications.

> Siplast Paradiene 30 FR TG BW

B. Flashing Membrane Assembly: A fluid-applied flashing membrane consisting of fluid-applied silane terminated polymer liquid reinforced with polyester fleece. A prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt sheet shall be used for flashing reinforcement and stripping. The back of the modified bitumen sheet shall be coated with factory applied polymer modified asphalt self-adhesive coating covered with a removable film. The top surface of the modified bitumen ply sheet shall be coated with a white acrylic coating to serve as a bleed-blocker.

> Siplast Paraflex 531 Liquid Flashing System

1. Self-Adhesive Modified Bitumen Stripping Ply and Flashing Reinforcing Sheet

a) Thickness (avg): 102 mils (2.6 mm) (ASTM D 5147)
b) Thickness (min): 98 mils (2.5 mm) (ASTM D 5147)
c) Weight (min per 100 ft² of coverage): 69 lb (3.4 kg/m²)
d) Maximum filler content in elastomeric blend: 35% by weight
e) Low temperature flexibility @ -15º F (-26º C) - PASS (ASTM D 5147)
f) Peak Load (avg) @ 73ºF (23ºC): 30 lbf/inch (5.3 kN/m) (ASTM D 5147)
g) Peak Load (avg) @ 0ºF (-18ºC): 75 lbf/inch (13.2 kN/m) (ASTM D 5147)
h) Ultimate Elongation (avg.) @ 73ºF (23ºC): 50% (ASTM D 5147)
i) Dimensional Stability (max): 0.1% (ASTM D 5147)
j) Compound Stability (min - sheet): 250ºF (121ºC) (ASTM D 5147)

k) Compound Stability (min – adhesive coating): 212ºF (100ºC) (ASTM D 5147)
l) Approvals: UL Class listed, FM Approved (products shall bear seals of approval)
m) Reinforcement: fiberglass mat or other meeting the performance and dimensional stability criteria
n) Back Surfacing: polyolefin release film
o) Top Surfacing: factory applied acrylic coating

> Pro Base SA by Siplast; Irving, TX

2. Resin for Flashing Applications: A flexible, single component, moisture-cured liquid membrane using silane terminated polymer technology.

a) Thickness (avg): 90 mils (2.3 mm) at 0.31 kg/ft² (3.3 kg/m²) coverage rate (ASTM D5147, section 6).
b) Peak Load (avg) @ 73°F (23ºC): 55 lbf/in (9.6 kN/m) (ASTM D5147 section 7)
c) Elongation at Peak Load (avg) @ 73°F: 35% (ASTM D5147, section 7)
d) Shore A Hardness (avg): 80 (ASTM D2240)
e) Water Absorption, Method I (24h @ 73°F): 0.8% (ASTM D570)
f) Water Absorption, Method II (48h @ 122°F): 1.2% (ASTM D570)
g) Low temperature flexibility @ -40° F (-40°C): PASS (ASTM D5147, section 12)
h) Dimensional Stability (max): 0.15% (ASTM D5147, section 11)
i) Tear Strength (avg): 60 lbf (0.4 kN) (ASTM D5147, section 8)
j) Water Vapor Transmission: 0.47 perms (ASTM E96)

> Paraflex 531 Liquid Flashing by Siplast; Irving, TX

3. Fleece for Flashing Membrane Reinforcement: A non-woven, 110 g/m², needle-punched polyester fabric reinforcement as supplied by the membrane system manufacturer.

> Pro Fleece by Siplast; Irving, TX

2.03 ROOFING ACCESSORIES

A. Roofing Adhesives

1. Insulation Adhesive: A single component, moisture cured, polyurethane foam adhesive, dispensed from a portable, pre-pressurized container used to adhere insulation panels to the substrate as well to other insulation panels.

> Para-Stik Insulation Adhesive by Siplast; Irving, TX

B. Bituminous Cutback Materials

1. Primer: An asphalt, solvent blend conforming to ASTM D 41 requirements.

> Siplast PA-1125 Asphalt Primer by Siplast; Irving, TX

2. Primer for Self-Adhesive Sheets: A quick drying, low-VOC, water-based, high-tack primer specifically designed to promote adhesion of roofing and waterproofing sheets to approved substrates. Primer shall meet South Coast Air Quality District and Ozone Transport Commission requirements.

   > Siplast TA-119 Primer by Siplast; Irving, TX

3. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges conforming to ASTM D 4586 Type II requirements.

   > Siplast PA-1021 Plastic Cement by Siplast; Irving, TX

C. Sealant: A moisture-curing, non-slump elastomeric sealant designed for roofing applications. The sealant shall be approved by the roof membrane manufacturer for use in conjunction with the roof membrane materials. Acceptable types are as follows:

   > Siplast PS-715 NS Elastomeric Sealant by Siplast; Irving, TX
   > Siplast PS 209 Elastomeric Sealant by Siplast; Irving, TX

D. Ceramic Granules: No. 11 grade specification ceramic granules of color scheme matching the granule surfacing of the finish ply.

E. Fasteners

1. Insulation Fasteners: Insulation fasteners and plates shall be FM Approved, and/or approved by the manufacturer of the primary roofing products. The insulation fasteners shall provide attachment required to meet the specified uplift performance and to restrain the insulation panels against the potential for ridging. The fastening pattern for each insulation panel to be used shall be as recommended by the insulation manufacturer and approved by the manufacturer of the primary roofing products. Acceptable insulation fastener manufacturers for specific deck types are listed below.

   a) Metal Decks: Insulation mechanical fasteners for metal decks shall be factory coated for corrosion resistance. The fastener shall conform meet or exceed Factory Mutual Standard 4470 and when subjected to 30 Kesternich cycles, show less than 15% red rust. Acceptable insulation fastener types for metal decks are listed below.

      - A fluorocarbon coated screw type roofing fastener having a minimum 0.220 inch thread diameter. Plates used in conjunction with the fastener shall be a metal type having a minimum 3 inch diameter, as supplied by the fastener manufacturer.

        > Parafast Fastener by Siplast; Irving, TX

2. Flashing Reinforcing Sheet Fasteners for Wood/Plywood Substrates to Receive Flashing Coverage: Fasteners shall be approved by the manufacturer of the primary roofing products. Acceptable fasteners for specific substrate types are listed below.

   a) Wood/Plywood Substrates

- A 12 gauge, spiral or annular threaded shank, zinc coated steel roofing fastener having a minimum 1 inch head.

  > Square Cap by W.H. Maze Co.; Peru, IL
  > 12 Gauge Simplex Nail by the Simplex Nail and Manufacturing Co., Americus, GA

F. Walktread: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface.

1. Thickness: 0.217 in (5.5 mm)
2. Weight: 1.8 lb/ft² (8.8 kg/m²)
3. Width: 30 in (76.2 cm)

> Paratread Roof Protection Material by Siplast; Irving, TX

PART 3 EXECUTION

3.00 Approved Installers:

Company	**Contact**	**Email**	**Phone**
James A. Edgar Co., Inc.	Chris Carr	ccarr@jaeroofinginc.com	518-346-8896
Midstate Industries	Mike Lucey	michael@midstateltd.com	518-374-1461
J & A Roofing	Rick Peruso	rick@jaroofing.com	845-339-2020
Titan Roofing, Inc.	Ed Wells	ewells@titanroofing.com	518-235-1707

A pre-job conference with the Manufacturer is required prior to proceeding with this work.

3.01 PREPARATION

A. General: Sweep or vacuum all surfaces, removing all loose aggregate and foreign substances prior to commencement of roofing.

B. Priming: Prime concrete substrate and masonry surfaces with a uniform coating of the specified primer.

3.02 SUBSTRATE PREPARATION

A. Gypsum Sheathing Panel: Install gypsum panels with end joints offset; edges of the panels shall be in moderate contact without forcing applied in strict accordance with the insulation manufacturer's requirements and the following instructions.

1. Gypsum Sheathing Panel: Mechanically attach the gypsum panels, using the specified fasteners, at a rate of 1 fastener for every 2.7 square feet of panel area (12 per 4' x 8' panel). Increase the fastening frequency by 50% at the perimeter of the roof and 100% in the corners.

B. Temporary Roof Application: Torch apply the ply sheets directly to the prepared substrate, lapping sides and ends a minimum of 3 inches. Apply the sheets free of wrinkles, creases or fishmouths and exert sufficient pressure on the roll during application to ensure the prevention of air pockets. Seal each penetration and termination using fiberglass tape and the specified plastic cement to ensure that the temporary roof configuration is completely water-tight.

C. Insulation: Install insulation panels with end joints offset; edges of the panels shall be in moderate contact without forcing applied in strict accordance with the insulation manufacturer's requirements and the following instructions. Where insulation is installed in two or more layers, stagger joints between layers. Maintain a maximum panel size of 4 feet by 4 feet for polyisocyanurate insulation applied in insulation adhesive.

1. Insulation - multiple layer: Install all layers in an application of the specified insulation adhesive in strict accordance with the requirements of the insulation adhesive supplier. Stagger the panel joints between insulation layers.

3.03 ROOF MEMBRANE INSTALLATION

A. Membrane Application: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing membrane components shall immediately follow application of base sheet and/or insulation as a continuous operation.

B. Aesthetic Considerations: Construction of an aesthetically pleasing overall appearance of the finished roof application is a standard requirement for this project. Make necessary preparations, utilize recommended application techniques, apply the specified materials including granules, and exercise care in ensuring that the finished application is acceptable to the Owner.

C. Priming with tacky primer: Apply the specified tacky primer by roller or spray in an even film. Refer to the manufacturer’s literature for the approved rate of application over various substrate types. Allow the primer to dry until it leaves a slightly sticky surface without transfer when touched.

D. Bitumen Consistency: Cutting or alterations of bitumen, primer, and sealants will not be permitted.

E. Roofing Application: Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets.

1. Apply all layers of roofing perpendicular to the slope of the deck.

2. Fully bond the base ply to the prepared substrate, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the torch applicator. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger end laps a minimum of 3 feet.

3. Fully bond the finish ply to the base ply, utilizing minimum 3 inch side and end laps. Apply each sheet directly behind the torch applicator. Stagger end laps of the finish ply a

minimum 3 feet. Cut a dog ear angle at the end laps on overlapping selvage edges. Using a clean trowel, apply top pressure to top seal T-laps immediately following sheet application. Stagger side laps of the finish ply a minimum 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum 3 feet from end laps in the underlying base ply.

4. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.

F. Granule Embedment: Broadcast mineral granules over all bitumen overruns on the finish ply surface, while the bitumen is still hot or the adhesive is soft, to ensure a monolithic surface color.

G. Preparation/Mixing Fluid-Applied Products: Prior to application, stir liquid materials for a minimum of 2 minutes using a spiral mixer or mixing paddle. To avoid aeration, do not use a spiral mixer unless the spiral section of the mixer can be fully contained in the liquid during the mixing process. Mix only enough product to ensure that it can be applied before pot life expires.

H. Water Cut-Off: At end of day's work, or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to the resumption of roofing.

3.04 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS

A. Walktread: Cut the walktread into maximum 5 foot lengths and allow to relax until flat. Adhere the sheet using the specified plastic cement. Apply the specified cement in a 3/8 inch thickness to the back of the product in 5 inch by 5 inch spots in accordance with the pattern as supplied by the walktread manufacturer. Walk-in each sheet after application to ensure proper adhesion. Use a minimum spacing of 2 inches between sheets to allow for proper drainage.

B. Sealant: Apply a smooth continuous bead of the specified sealant at the exposed finish ply edge transition to metal flashings incorporated into the roof system.

3.05 FIELD QUALITY CONTROL AND INSPECTIONS

A. Site Condition: Leave all areas around job site free of debris, roofing materials, equipment and related items after completion of job.

B. Notification Of Completion: Notify the manufacturer by means of manufacturer's printed Notification of Completion form of job completion in order to schedule a final inspection date.

C. Final Inspection

1. Post-Installation Meeting: Hold a meeting at the completion of the project, attended by all parties that were present at the pre-job conference. A punch list of items required for completion shall be compiled by the Contractor and the manufacturer's representative. Complete, sign, and mail the punch list form to the manufacturer's headquarters.

D. Issuance Of The Guarantee: Complete all post installation procedures and meet the manufacturer's final endorsement for issuance of the specified guarantee.

SECTION 076000 - FLASHING AND SHEET METAL

1. Summary:

   A. This Section includes but is not limited to the following:

      1. Metal wall flashing in sufficient dimension, appropriate shapes and material, and proper installation, to prevent water from penetrating into building.

2. Submittals:

   A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

   B. Product data, Flashing, Sheet Metal, and Accessories: Manufacturer's technical product data, installation instructions and general recommendations for each specified sheet material and fabricated product.

   C. Samples of the following flashing, sheet metal, and accessory items:

      1. 8-inch-square samples of specified sheet materials to be exposed as finished surfaces.
      2. 12-inch-long samples of factory-fabricated products exposed as finished work. Provide complete with specified factory finish.

   D. Shop drawings showing layout, profiles, methods of joining, and anchorages details. Provide layouts at 1/4-inch scale and details at 3-inch scale.

3. Project Conditions:

   A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

4. Sheet Metal Flashing and Trim Materials:

Condition	Material
Flashing @ Roofing	See sections 075201, 075202
Flashing @ Roof Specialties	See section 077100
Flashing @ Roof Accessories	See section 077200
Flashing @ EIFS	Stainless-Steel: ASTM A 167, Type 304, fully annealed, 26 gage min., 2d Finish.
Through Wall Flashing @ Masonry	Stainless-Steel: ASTM A 167, Type 304, fully annealed, 26 gage min., 2d Finish.
Above Lintel @ Lintel Replacement	Stainless-Steel: ASTM A 167, Type 304, fully annealed, 26 gage min., 2d Finish.
Below Window Sill @ Window Replacement	Aluminum Sheet: ASTM B 209 (ASTM B 209M), Kynar color finish, 0.050”

5. Installation Requirements:

   A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with SMACNA "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

Commented [COMMENT1]: THIS SECTION USES THE TERM "ARCHITECT." CHANGE THIS TERM AS NECESSARY TO MATCH THE ACTUAL TERM USED TO IDENTIFY DESIGN PROFESSIONAL AS DEFINED IN THE GENERAL AND SUPPLEMENTARY CONDITIONS.

Commented [COMMENT2]: EDIT EXAMPLES BELOW BY DELETING ITEMS NOT REQUIRED, ADDING OTHERS, OR REVISING TEXT TO CLARIFY DESCRIPTIONS.

Commented [COMMENT3]: RETAIN ABOVE AND INSERT SPECIFIC DATA SUBMITTALS AS DESIRED.

Commented [COMMENT4]: DELETE ABOVE AND BELOW IF NO CONTROL REQUIRED ON SHEET MATERIALS. DELETE BELOW IF VISUAL CONTROL OF TRIM UNITS, GUTTERS, DOWNSPOUTS, EXPANSION JOINT UNITS, ETC. IS NOT DESIRED.

Commented [COMMENT5]: DELETE BELOW IF NONE OF WORK SUFFICIENTLY COMPLEX TO JUSTIFY SHOP DRAWINGS; EDIT TO DELETE NONAPPLICABLE UNITS. POSSIBLY INSERT PRODUCT-HANDLING ARTICLE WHERE SUBSTANTIAL VOLUME OF HIGHLY FINISHED WORK IS REQUIRED.

Commented [COMMENT6]: POSSIBLY INSERT QUALITY ASSURANCE ARTICLE HERE FOR LIMITATIONS ON FABRICATORS OR INSTALLERS OF COMPLEX SYSTEMS OF FLASHING, RAIN DRAINAGE, EXPANSION JOINTS, ETC.

Commented [COMMENT7]: POSSIBLY INSERT HERE SPECIAL PROJECT WARRANTY REQUIREMENTS FOR EXTENSIVE/ ELABORATE (ESPECIALLY PREFAB) SYSTEMS.

B. Underlayment: Where stainless steel or aluminum is to be installed directly on cementitious or wood substrates, install a slip sheet of 5-lb red rosin paper and a course of 6-mil polyethylene underlayment.

C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

D. Install reglets to receive counterflashing in manner and by methods indicated. Where shown in concrete, furnish reglets to trades of concrete work for installation as work of Division 3 sections. Where shown in masonry, furnish reglets to trades of masonry work, for installation as work of Division 4 sections.

E. Install counterflashing in reglets, either by snap-in seal arrangement or by welding in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.

6. Cleaning and Protection:

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Protection: Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

END OF SECTION 076000

Commented [COMMENT8]: DELETE ABOVE IF NO REGLETS REQUIRED. ADJUST PROVISIONS OF TEXT TO CONFORM WITH LOCAL PRACTICE AND TRADE JURISDICTIONS.

077100 – ROOF SPECIALTIES

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Copings.
   2. Roof-edge flashings.
   3. Roof-edge drainage systems.
   4. Reglets and counterflashings.

B. Related work specified elsewhere:
   1. Division 07 Section “Roof Accessories”

1.03 PERFORMANCE REQUIREMENTS

A. FM Approvals' Listing: Manufacture and install copings and roof-edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, [Class 1-90]. Identify materials with FM Approvals' markings.

B. SPRI Wind Design Standard: Manufacture and install copings and roof-edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressures:
   1. Design Pressure: Maximum uplift is 60PSF

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified.

D. Product test reports.

E. Maintenance data.

F. Warranty: Sample of special warranty.

1.05 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1.06 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 EXPOSED METALS

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
   1. Surface: Smooth, flat finish.
   2. Mill Finish: As manufactured.
   3. Exposed Coil-Coated Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Three-Coat Fluoropolymer: AAMA 620. System consisting of primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent PVDF resin by weight.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.02 CONCEALED METALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

2.03 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
   2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).

C. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

2.04 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.05 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.
Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Architectural Products Company.
b. ATAS International, Inc.
c. Castle Metal Products.
d. Cheney Flashing Company.
e. Hickman Company, W. P.
f. Johns Manville.
g. Merchant & Evans, Inc.
h. Metal-Era, Inc.
i. Metal-Fab Manufacturing, LLC.
j. MM Systems Corporation.
k. National Sheet Metal Systems, Inc.
l. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
m. Petersen Aluminum Corporation.
1. Coping-Cap Material: Formed aluminum, thickness as required to meet performance

requirements.

a. Finish: Three-coat fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

2. Corners: Factory mitered and continuously welded.
3. Coping-Cap Attachment Method: **[Snap-on]** **[Face leg hooked to continuous cleat with back leg fastener exposed]**, fabricated from coping-cap material.
4. Snap-on-Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.
5. Face Leg Cleats: Concealed, continuous **stainless steel**.

2.06 ROOF-EDGE FLASHINGS

A. Canted Roof-Edge Fascia and Gravel Stop: Manufactured, two-piece, roof-edge fascia consisting of **[snap-on]** **[compression-clamped]** metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed galvanized-steel sheet cant, 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Architectural Products Company.
   b. ATAS International, Inc.
   c. Castle Metal Products.
   d. Cheney Flashing Company.
   e. Hickman Company, W. P.
   f. Johns Manville.
   g. Merchant & Evans, Inc.
   h. Metal-Era, Inc.
   i. Metal-Fab Manufacturing, LLC.
   j. MM Systems Corporation.
   k. National Sheet Metal Systems, Inc.
   l. Petersen Aluminum Corporation.
2. Fascia Cover: Fabricated from the following exposed metal:
   a. Formed Aluminum: Thickness as required to meet performance requirements.
   b. Zinc-Coated Steel: Nominal thickness as required to meet performance requirements.
3. Corners: Factory mitered and continuously welded.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.
5. Fascia Accessories: Overflow scuppers.

B. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed- or extruded-aluminum anchor bar with integral drip-edge cleat to engage fascia cover. Provide matching corner units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hickman Company, W. P.
   b. Johns Manville.
   c. Metal-Era, Inc.
   d. Metal-Fab Manufacturing, LLC.
   e. National Sheet Metal Systems, Inc.
   f. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
2. Fascia Cover: Fabricated from the following exposed metal:

a. Formed Aluminum: Thickness as required to meet performance requirements.

b. Zinc-Coated Steel: Nominal thickness as required to meet performance requirements.

3. Corners: Factory mitered and soldered.
4. Splice Plates: Concealed , of same material, finish, and shape as fascia cover.
5. Fascia Accessories: Overflow scuppers.

C. One-Piece Gravel Stops: Manufactured, one-piece, metal gravel stop in section lengths not exceeding 12 feet (3.6 m), with a horizontal flange and vertical leg, drain-through fascia terminating in a drip edge, and concealed splice plates of same material, finish, and shape as gravel stop. Provide matching corner units.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   a. Architectural Products Company.
   b. Berger Building Products, Inc.
   c. Castle Metal Products.
   d. Cheney Flashing Company.
   e. Hickman Company, W. P.
   f. Metal-Era, Inc.
   g. Metal-Fab Manufacturing, LLC.
   h. MM Systems Corporation.
   i. National Sheet Metal Systems, Inc.
   j. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.
   k. Petersen Aluminum Corporation.
2. Fabricate from the following exposed metal:
   a. Formed Aluminum: Thickness as required to meet performance requirements.
   b. Zinc-Coated Steel: Nominal thickness as required to meet performance requirements.
3. Corners: Factory mitered and continuously welded.

D. Aluminum Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

E. Zinc-Coated Steel Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.07 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Castle Metal Products.
2. Cheney Flashing Company.
3. Fry Reglet Corporation.
4. Heckmann Building Products Inc.
5. Hickman Company, W. P.
6. Keystone Flashing Company, Inc.
7. Metal-Era, Inc.
8. Metal-Fab Manufacturing, LLC.
9. MM Systems Corporation.

10. National Sheet Metal Systems, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
   1. Formed Aluminum: 0.050 inch (1.27 mm) thick.
   2. Stainless Steel: 0.025 inch (0.64 mm) thick.
   3. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.
   4. Corners: Factory mitered and continuously welded.
   5. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   6. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
   7. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
   8. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
   9. Multiuse Type, Embedded: For multiuse embedment in cast-in-place concrete and masonry mortar joints.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
   1. Formed Aluminum: 0.032 inch (0.81 mm) thick.
   2. Stainless Steel: 0.025 inch (0.64 mm) thick.
   3. Zinc-Coated Steel: Nominal 0.028-inch (0.71-mm) thickness.

D. Accessories:
   1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
   2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Aluminum Finish: Three-coat fluoropolymer.
   1. Color: As selected by Architect from manufacturer's full range.

F. Stainless-Steel Finish: No. 4 (bright, polished directional satin).

G. Zinc-Coated Steel Finish: Three-coat fluoropolymer.
   1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use

fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Install underlayment with adhesive for temporary anchorage. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm). Roll laps of self-adhering sheet underlayment with roller; cover within 14 days.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment or polyethylene sheet.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise shown on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.02 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to meet performance requirements.
1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance

requirements.

2. Interlock face leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.03 ROOF-EDGE FLASHING INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.04 REGLET AND COUNTERFLASHING INSTALLATION

A. Embedded Reglets: See Division 03 Section "Cast-in-Place Concrete" and Division 04 Section "Unit Masonry" for installation of reglets.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Fit counterflashings tightly to base flashings.

3.05 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed.

End 077100

077200-ROOF ACCESSORIES

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Roofing at roof curbs (curbs are provided/installed in the Mechanical section)
   2. Roofing at equipment supports (equipment supports are provided/installed in the Structural section)

1.03 SUBMITTALS

A. Product Data: For each type of roof accessory indicated.

B. Shop Drawings: Show fabrication and installation details for roof accessories.

C. Samples: For each type of exposed factory-applied finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.

1.04 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.02 METAL MATERIALS

A. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755/A 755M.
   1. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated.
   2. Exposed Finishes: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and finish. Coil-coat finish as follows:
   1. Factory-Prime Coating: Where painting after installation is indicated, provide pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat; with a minimum dry film thickness of 0.2 mil (0.005 mm).
   2. High-Performance Organic Finish: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.
      a. Color and Gloss to be selected by the Architect from manufacturer's full range.

2.03 ROOF CURBS

A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with integral metal cant and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
   1. Manufacturers:
      a. Conn-Fab Sales, Inc.
      b. Curbs Plus Inc.
      c. Custom Curb, Inc.
      d. LM Curbs.
      e. Loren Cook Company.
      f. Metallic Products Corporation.
      g. Nystrom, Inc.
      h. Pate Company (The).
      i. Roof Products & Systems Corporation.
      j. Roof Products, Inc.
      k. Thaler Metal Industries Ltd.
      l. ThyCurb; Div. of Thybar Corporation.
      m. Uni-Curb, Inc.
      n. Vent Products Company, Inc.
   2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
   3. Factory install wood nailers at tops of curbs.
   4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
   5. Factory insulate curbs with 1-1/2-inch- (38-mm-) thick, glass-fiber board insulation.
   6. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.
   7. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.04 EQUIPMENT SUPPORTS

A. Equipment Supports: Provide metal equipment supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and

other construction to be supported. Fabricate with welded or sealed mechanical corner joints, with integral metal cant and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1. Manufacturers:
   a. Conn-Fab Sales, Inc.
   b. Curbs Plus Inc.
   c. Custom Curb, Inc.
   d. LM Curbs.
   e. Loren Cook Company.
   f. Metallic Products Corporation.
   g. Nystrom, Inc.
   h. Pate Company (The).
   i. Roof Products & Systems Corporation.
   j. Roof Products, Inc.
   k. Thaler Metal Industries Ltd.
   l. ThyCurb; Div. of Thybar Corporation.
   m. Uni-Curb, Inc.
   n. Vent Products Company, Inc.
2. Factory-install continuous wood nailers 5-1/2 inches (140 mm) wide at tops of equipment supports.
3. Metal Counterflashing: Manufacturer's standard removable counterflashing, fabricated of same metal and finish as equipment support.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.
6. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

2.05 ROOF HATCHES

A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Manufacturers:
   a. Babcock-Davis; a Cierra Products Inc. Company.
   b. Bilco Company (The).
   c. Custom Curb, Inc.
   d. J. L. Industries, Inc.
   e. Metallic Products Corporation.
   f. Milcor Inc.; a Gibraltar Company.
   g. Nystrom, Inc.
   h. O'Keeffe's Inc.
   i. Roof Products & Systems Corporation.
   j. ThyCurb; Div of Thybar Corporation.

k. Wasco Products, Inc.

2. Type and Size: Single-leaf lid, 30 by 36 inches (750 by 900 mm).
3. Curb and Lid Material: Galvanized steel sheet, 0.079 inch (2.0 mm) thick.
4. Curb and Lid Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.

a. Finish: High-performance organic coating or powder coat.

5. Insulation: Glass-fiber board.
6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.
7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.
8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
9. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.
10. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate hatch curbs with height tapered to match slope to level tops of units.
11. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
    a. Provide 2-point latch on covers larger than 84 inches (2130 mm).
    b. Provide remote-control operation.
12. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.

2.06 ROOF ANCHORS FOR FALL ARREST

A. Design Criteria:
1. Design anchors to resist without fracture a pull-out force of 5400 lbs (24.03 kN), applied in the most adverse direction.
2. Design safety anchor fall protection system to provide for safe execution of window washing or other suspended maintenance operations.

B. Anchors: Provide metal rooftop supports, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads to be supported. Fabricate with welded joints, with prefabricated metal flashing ring and concealed integral mounting flange at bottom, bolted through roof deck and around structure below.
1. Manufacturer: Thaler Metal Industries, Ltd., or approved equal.
2. Product: Thaler FARA-3 with galvanized forged 1018 steel eye, or approved equal.
3. Material:
    a. Body: Urethane insulated hollow hot dipped galvanized ASTM 500C steel post (HSS) 1/4" (6 mm) wall thickness x 4-1/2" (114 mm) dia. x 12" (305 mm) high welded to 5/8" x 8" x 8" (16 mm x 203 mm x 203 mm) 44W base plate.
    b. Connectors: Four 5/8" (16 mm) Type 304 s.s. bolts and 5/8" x 8" x 8" (16 mm x 203 mm x 203 mm) under-beam plate, lock washers and nuts.
    c. Flashing: SJ-37(9) 9" (229 mm) high flashing of 0.064" (1.6 mm) mill- finish 1100-0T alloy aluminum to CSA B272-93, with EPDM Triple Pressure Grommet Seal and EPDM Base Seal and PVC coated deck flange.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
   3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Seal joints with elastomeric sealant as required by manufacturer of roof accessories.

END OF SECTION 07 72 00

SECTION 078400 - FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

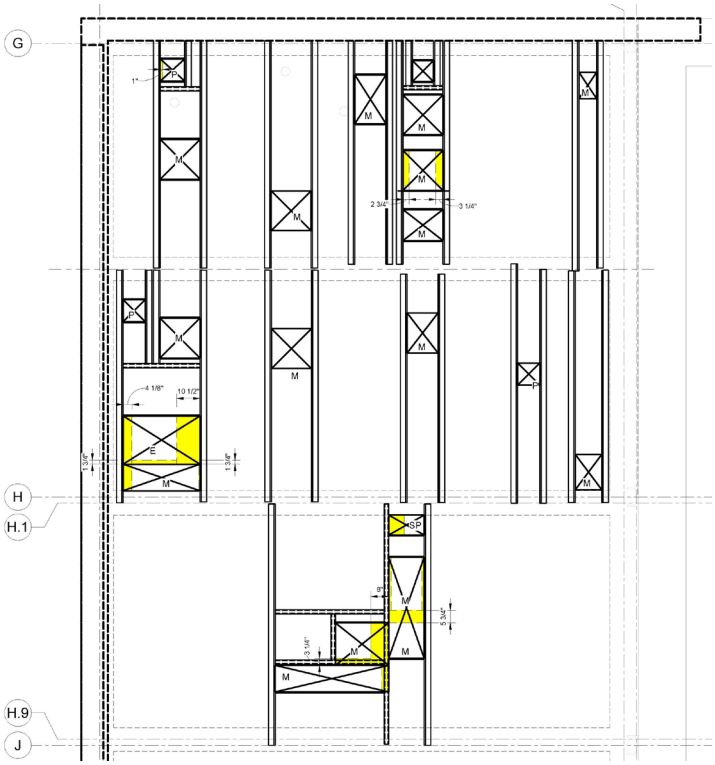
A. Section Includes the following items performed in the work of the General Contract:

1. Sealant joints in fire-resistance-rated construction.
2. Penetrations in fire-resistance-rated walls.
3. Penetrations in horizontal assemblies.
4. Penetrations in smoke barriers.

B. Contractor installing this work must be a FM 4991 APPROVED FIRESTOP CONTRACTOR.

C. Firestop assembly must follow a UL-listed assembly.

D. Maximum joint size per the above UL assembly. If dimension between duct and slab opening exceeds the allowable width, infill opening with either concrete or a UL listed 1 hour rated assembly to reduce opening width of joint as required. Areas shown in yellow below will require this work:



1.3 QUALITY ASSURANCE

B. Fire-Test Response Characteristics

1. Provide fire-resistive joint sealant systems identical to those tested for fire-response characteristics per ASTM E119. Provide systems complying with the following requirements:

a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.

2. For firestopping exposed to view, traffic, moisture and physical damage, provide products that do not deteriorate when exposed to these conditions and provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E84.

C. Installer Qualifications: Engage an experienced Installer who has completed firestopping that is similar in material, design and extent to that indicated for the Project and is trained or approved by the fireproofing manufacturer.

D. Single-Source Responsibility: Where possible, obtain firestop systems for each condition from a single manufacturer.

E. Provide firestopping products containing no detectable asbestos.

F. Preinstallation Conference: Conduct conference at Project site.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data indicating product characteristics, performance and limited criteria and recommended installation instructions for each type of firestop product required by the project.

1. Indicate design number for each firestop proposed to be used which is detailed in the UL Fire Resistance Directory, Factory Mutual Approval Guide, or the other laboratory directories acceptable to the code authority.
2. State the specific locations where each firestop system is proposed to be installed.

B. Product test reports from, and based on tests performed by a qualified testing and inspecting agency, evidencing compliance of firestopping with requirements for each condition indicated.

C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

D. Field-Constructed Mock-up: Prior to installing firestopping, erect mock-ups for each different firestop system indicated to verify selections made and to demonstrate qualities of materials

and execution. Building mock-ups to comply with the following requirements, suing materials indicated for final installations.

1. Locate mock-ups on site in locations confirmed in writing with the Architect.
2. Notify Architect in advance of the dates and times when mock-ups will be erected.
3. Obtain Architect's acceptance in writing of mock-ups before start of work.
4. Approved mock-ups may be left in place as part of the finished project and will constitute the standard for remaining work.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time and mixing instructions for multicomponent materials.

B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.5 JOB CONDITIONS

A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet.

B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

1.7 SYSTEMS DEMONSTRATION - This section not required.

1.8 QUALITY ASSURANCE TESTING

A. An inspecting agency employed by the Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements. The inspecting agency will report observations promptly and in writing to Contractor and Architect. Do not enclose firestopping with other construction until reports of examinations are issued. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

B. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

1.9 EXTRA STOCK - This section not required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.

E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. Firestop Sealant: Single-component, silicone based sealant.

1. Dow Corning Firestop Sealant 2000 or SL 2003 by Dow Corning.
2. CS240 Firestop Sealant by Hilti Construction Chemicals, Inc.
3. Fyre-Sil or Fyre-Sil S/L by Tremco, Inc.

G. Noncombustible Mineral Wool Insulation: Thermafiber Safing Insulation by US Gypsum or accepted equal. Provide 4 pcf minimum density.

H. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:

a. Slag-wool-fiber or rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
2. Clean opening and joint substrates and penetrating items to product clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form release agents from concrete.

B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIRE-RESISTIVE JOINT SEALANTS

A. General: Comply with ASTM C1193 and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install joint fillers to provide support of sealants during application and at position required to product the cross-sectional shapes and depths of installed sealants relative to joint widths.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint width that allow optimum sealant movement capability and develop fire-resistance rating required. Install sealants at the same time joint fillers are installed.

D. Tool nonsag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint.

3.5 PARTITION CONTROL JOINTS

A. Firesafe control joints in CMU partitions by stuffing joint between CMU full with noncombustible mineral wool insulation and providing a continuous bead of firestop sealant to the minimum depth recommended by the manufacturer to achieve the fire resistance rating required on both sides of side of partition.

3.6 PARTITION PERIMETERS

A. Noncombustible mineral wool insulation or firesafing sealant is not required at the base, side or top of fire/smoke barrier partition where the gap is between the adjacent surface does not exceed 1/8".

B. Firesafe gaps at the top of partitions abutting floor structure above by stuffing full void between top of partition and underside of floor with noncombustible mineral fill and providing a continuous bed of firestop sealant to the minimum depth as recommended by the manufacturer on both sides of the partition.

3.7 FLOOR PERIMETERS

A. Firesafing to seal the gap between a fire rated floor and fire rated walls or shafts shall be continuous. The gap will be filled full depth of the floor slab with noncombustible mineral wool insulation and topped with continuous bead of firestop sealant to the minimum depth as recommended by the manufacturer.

3.8 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical

fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.10 CLEANING

A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products.

B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION 078400

SECTION 079000 JOINT SEALERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included

1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:

a. Control and expansion joints in unit masonry.
b. Joints between different materials listed above.
c. Joints between frames of doors and windows and adjacent materials.
d. Joints where required for a watertight or visually complete job.

2. Interior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:

a. Joints between frames of doors and windows and adjacent materials.
b. Joints between dissimilar materials.
c. Joints where required for a visually complete job.

3. Interior joints in cleanrooms: Use sealant approved for cleanroom environments. See material section below.

4. Control and expansion joints within exterior EIFS system and where EIFS meets other materials are included in section 072400- EIFS.

1.3 QUALITY ASSURANCE

A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Installer Qualifications: Engage an experienced Installer with ten (10) years of continuous joint sealant installation experience who has completed joint sealant applications similar in material, design and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.

C. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

D. Field-Constructed Mock-Ups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Joints in field-constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants specified in this Section.

E. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of the Division 1 Section covering this activity.

1.4 SUBMITTALS

A. Product data from manufacturers for each joint sealant product and control joint required.

1. Certification by joint sealant manufacturer that sealants plus the primers and cleaners required for sealant installation comply with regulations controlling use of volatile organic compounds.

B. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

C. Samples for verification purposes of each type and color of joint sealant and control joint required. Install joint sealant samples in 1/2" wide joints formed between two 6" long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1. Joint-Sealant Schedule: Include the following information:

a. Joint-sealant application, joint location, and designation.
b. Joint-sealant manufacturer and product name.
c. Joint-sealant formulation.
d. Joint-sealant color.

2. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

D. Qualification data complying with requirements specified in "Quality Assurance" article. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.

E. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

F. Products test reports for each type of joint sealants indicated, evidencing compliance with requirements specified.

G. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use and curing time.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions.

1. When ambient and/or substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
2. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less or greater than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.7 WARRANTIES

A. General: Upon completion of the work and as a condition of its acceptance, deliver to the Owner, the following written warranties, in a form acceptable to the Architect, signed and notarized.

1. Exterior Sealant Installer Special Warranty: Provide written warranty that the entire exterior sealant installation, including sealants and all other materials and work of this Section will remain intact and free from leaks of any kind and from all other defects for a period of at least ten (10) years following acceptance of the sealant installation and that all repairs and/or replacements, including all labor and material, will be made promptly to the satisfaction of the Architect and at no additional cost to the Owner.
2. Manufacturer's Weatherseal Warranty: Provide a written warranty by the manufacturer of the installed sealant indicating that the building sealant used will perform as a watertight weatherseal for a period of twenty (20) years from the date of acceptance of the sealant installation. All manufacturer's requirements concerning application procedures, material compatibility, shelf life time requirements and testing shall be performed by the installer as a requirement of this warranty. The manufacturer shall agree to provide replacement material for any repairs made necessary by a failure of this sealant under this warranty.

3. Manufacturer's Non-Staining Warranty: Provide a written warranty by the manufacturer of the installed sealant indicating that the building sealant used will not cause porous substrates to discolor or change their appearance for a period of twenty (20) years from the date of acceptance of the sealant installation. All manufacturer's requirements concerning this warranty shall be performed by the installer as a requirement of this warranty. The manufacturer shall agree to provide the cost of replacement material and labor and any repairs made necessary by a failure of the sealant under this warranty.

1.8 SYSTEMS DEMONSTRATION - ***This section not required.***

1.9 QUALITY ASSURANCE TESTING

A. Preconstruction Field Testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows.

1. Locate test joints where indicated or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated, for each type of elastomeric sealant and joint substrate indicated.
3. Notify Architect one week in advance of the dates and times when Preconstruction Field Testing will be completed.
4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants by hand pull method described below.

a. Install joint sealants in 5' joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed work. Allow sealants to cure fully before testing.
b. Make knife cuts horizontally from one side of joint to the other followed by two vertical cuts approximately 2" long at side of joint and meeting horizontal cut at top of 2" cuts. Place a mark 1" from top of 2" piece.
c. Use fingers to grasp 2" piece of sealant just above 1" mark; pull firmly down at a 90^{O} angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

6. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
7. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.10 EXTRA STOCK – 10% of material supplied or one new container, whichever is more.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealants to comply with the following. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

2.2 CLEAN ROOM SEALANTS

A. Use: Dow Corning 798+ Bacteria Resistant Cold & Clean Room Silicone Sealant

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and other requirements indicated on each Elastomeric Joint Sealant Data Sheet at end of this Section, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class and Uses.

1. Additional Movement Capability: Where additional movement capability is specified in Elastomeric Joint Sealant Data Sheet, provide products with the capability when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

B. Available Products: Subject to compliance with requirements, elastomeric sealants that may be incorporated in the work include, but are not limited to, the products specified in each Elastomeric Sealant Data Sheet. For cleanroom sealants, see 2.2A.

2.4 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Closed-cell polyethylene foam, nonabsorbent to liquid, water and gas, nonout-gassing in enraptured state.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 CONTROL JOINTS

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined by preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt and frost.
2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form release agents from concrete.
4. Clean metal, glass, porcelain, enamel, glazed surfaces of ceramic tile and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements.

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.
b. Do not stretch, twist, puncture or tear joint fillers.
c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer. Provide concave joint configuration per Figure 5A in ASTM C 62, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joints sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that any installations with repaired areas are indistinguishable from original work.

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3.6 ELASTOMERIC JOINT SEALANT SCHEDULE

A. Exterior Sealant (Type 1)

1. Base Polymer: Neutral-curing silicone.
2. Type: S (single component).
3. Grade: NS (nonsag).
4. Class: 25 (minimum movement of + 25 percent).
5. Additional Movement Capability: 50% movement in extension and 50% in compression for a total of 100% movement.
6. Use Related to Exposure: NT (nontraffic).
7. Uses Related to Joint Substrates: M, G, A and joint substrates O indicated on drawings.
8. Acceptable Products:

    a. Dow Corning Corporation No. 790 Silicone Building Sealant.
    b. General Electric Company Silicone SILPRUF.
    c. Sonneborn Sonolastic Omniseal.

B. Exterior Sealant (Type 2)

1. Base Polymer: Polyurethane.
2. Type: M (multi-component).
3. Grade: NS (non-sag).
4. Class: 25 (minimum movement of + 25 percent).
5. Use Related to Exposure: NT (non-traffic).
6. Use Related to Joint Substrates: M, G, A and joint substrates O indicated on drawings.
7. Acceptable Products

    a. Sonneborn Sonolastic NP2.
    b. Sika Sikaflex 2cNS.
    c. Pecora Dynatrol II.

C. Interior Sealant

1. Base Polymer: Polyurethane.
2. Type: M (multi-component).

3. Grade: NS (non-sag).
4. Class: 25 (minimum movement of + 25 percent).
5. Use Related to Exposure: NT (non-traffic).
6. Use Related to Joint Substrates: M, G, A and joint substrates O indicated on drawings.
7. Acceptable Products

    a. Sonneborn Sonolastic NP2.
    b. Sika Sikaflex 2cNS.
    c. Pecora Dynatrol II.

D. Paving Joint Sealant

1. Base Polymer: Polyurethane.
2. Type: M (multi-component).
3. Grade: P (pourable).
4. Class: 25.
5. Additional Movement Capability: 25% movement in extension and 25% movement in compression for a total of 50% movement.
6. Use Related to Exposure: T (traffic grade).
7. Acceptable Products:

    a. Sonneborn Sonolastic SL2 or accepted equal.
    b. Pecora NR-200 Urexpan.
    c. Sika Corp Sikaflex-2cSL.

END OF SECTION 079000

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

1.1 SUMMARY

A. Interior hollow metal doors.

B. Interior hollow metal frames

C. Interior hollow metal windows/sidelights. (not used)

1.2 SUBMITTALS

A. Product Data: Submit manufacturers specifications for fabrication and installation including data demonstrating compliance with specified requirements.

B. Shop Drawings: Submit shop drawings describing fabrication and installation of hollow metal doors and frames and related accessory items, including, but not limited to the following:

1. Frame configuration, anchor spacings, anchor types, locations of hardware and reinforcement cutouts, joints and connections. Indicate frame assemblies too large to ship in one piece, and include locations and details of field splice joints with complete instructions for making field splices.
2. Door elevations, stiles and rail reinforcement, edge closures, cutouts and details for glazed and solid panels and louvers.

C. Submit schedule of doors and frames using same reference numbers as shown on drawings.

1.3 QUALITY ASSURANCE

A. Requirements: ANSI/SDI 100.

B. Fire Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspection agency acceptable to authorities having jurisdiction, for fire protection ratings indicated, based on testing according to NFPA 252.

1. Oversize Fire Rated Doors Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors and frames comply with construction requirements for tested and labeled fire rated assemblies except for size.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver steel doors, frames and related components in cartons, crates or similar wrapping to adequately protect units from damage due to handling and storage.

B. Store units in a dry area under cover. Place units on wood sills or on the floor in a manor that will prevent rust and damage. If wrapper becomes wet, remove the carton immediately. Provide a ¼" space between stacked doors to promote air circulation.

C. Inspect material upon delivery for damage and notify shipper and supplier if damage is found. Minor damage may be repaired provided refinished items match new work and are acceptable to the Architect. Remove and replace damaged items that cannot be repaired as directed.

2.1 PRODUCTS

A. Manufacturers:

1. Ceco Door Products
2. Other American SDI members that conform to the specific requirements of this specification

B. General:

1. Steel: commercial quality, level, cold rolled, complying with ASTM A 366.
2. Galvanizing: Comply with ASTM A525, min. 0.60 oz. / sq. ft.
3. Prepare doors and frames to receive mortised and concealed hardware according to approved hardware schedule. Reinforce doors and frames for surface applied hardware. Drilling and tapping may be done at project site.
4. Factory-fit doors to frames. Edge gap requirements are: a. jambs and heads 3/32" b. meeting edges pairs of doors 1/8" c. bottoms ¾" where no sill 3/8" raised non-combustible sill 5/8" rigid floor tile ½" floor coverings

C. Doors General:

1. 7 ga. hinge reinforcement.
2. 12 ga. closer reinforcement.
3. Balance of hardware reinforcements is in accordance with the minimum standard gages as listed in SDI-100.
4. Reinforce tops and bottoms of all doors with continuous steel channel not less than 16 gage, extending full width of door and welded to face sheets.

D. Interior Doors:

1. Grade: SDI level 2, heavy duty 18 ga. cold rolled, model1.
2. Core: Resin Impregnated kraft honeycomb with sanded edges securely bonded to both face sheets.

E. Exterior Doors: (Door 302 covered by this section, Door 301 covered by section 084113)

1. Grade: SDI level 3, extra heavy-duty 16 ga. Galvanized, model 1.
2. Core: foamed in place polyurethane.
3. Close top and bottom edges of doors flush as an integral part of door construction or by addition of steel channels with channel webs placed flush with top and bottom edges.

F. Door Louvers: (not used)

G. Lite Kits:

1. 18 ga. galvannealed steel to accommodate glass thickness and size of vision lite indicated.
2. All cross-corridor doors to have lite kits. Size determined by fire rating.

H. Frames General:

1. 7 ga. hinge reinforcement.
2. 10 ga. closer reinforcement.
3. Balance of hardware reinforcements is in accordance with the minimum standard gages as listed in SDI-100.

I. Interior Frames:

1. 16 ga., cold rolled for openings up to 4 ft. wide.
2. 14 ga. cold rolled for openings over 4 ft. wide.
3. Frames over 3'-0" x 7'-0" to be welded.
4. Frames being installed in a masonry application to be welded.
5. Frames being installed in a non-corridor application can be knockdown, if approved by the Facilities Director.

J. Exterior Frames: (Door 302 covered by this section, Door 301 covered by section 084113)

1. 14 ga. Galvanized.
2. Welded up.

K. Hospital stops to be provided on all interior doors for Medical Center projects.

L. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single doors frames and two silencers on heads of double doorframes.

M. Supports and Anchors: provide appropriate type and gauges of anchors for specific wall construction as recommended by SDI.

N. Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance and free from defects including warp and buckle.

O. Primer: Rust inhibitive enamel or paint, either air-drying or baked, suitable as base for finish paint.

2.2 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Weld exposed joints and make smooth, flush and invisible by filling or grinding and dressing. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/NAAMM-HMMA 861.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.
3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. All Frames on this Project to be Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/NAAMM-HMMA 861.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
5. Weld 14 gage steel tongues, 1-1/2 inch high, inside lock mortise to keep lock body centered in door.
6. Fabricate doors and frames with 7 gage reinforcement for hinges and pivots. Use 12 gage reinforcement for all other hardware.
7. Reinforce doors not mortised for concealed door closers for surface door closer application and all frames for closer arm application, whether or not closers are specified.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow metal work.
5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.3 FABRICATION TOLERANCES

A. Clearances: Fabricate doors for their respective frames within the following clearances.

1. Non-Fire Rated Doors, Jambs and Head: 3/32 to 1/8 inch.

a. Meeting Edges of Pairs: 1/8 to 3/16 inch.
b. Bottom (no threshold or carpet): 3/8 inch, maximum.
c. Bottom (at threshold or carpet): 1/4 inch, maximum.

2. Fire Rated Doors: Comply with clearances specified in NFPA Standard No. 80.

2.4 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2. Chemically wash, rinse and dry exposed and concealed surfaces of fabricated units.

3. Apply one coat of primer to all surfaces and oven-bake units to achieve a minimum dry film thickness of 1.25 mils.

4. Units shall be capable of passing the following tests:

a. Salt Spray Test complying with ASTM B117 for 120 continuous hours.
b. Water Fog Test complying with ASTM D1735 for 240 continuous hours.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with HMMA 840.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable glazing stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 08 Sections "Glazing", "Security Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 083459 - VAULT DOOR AND DAY GATE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes supply and installation of: factory finished vault door and day gate – both complete with frame, hardware, threshold and day gate. This project has one vault door and one vault day gate. This section includes supply and installation.

1.2 NYS REGULATORY REQUIREMENTS

The Vault Room, Vault Door, and Vault Day Gate Must Conform to the Following Requirements: (Part 80: Rules and Regulations on Controlled Substances in NYS)

A vault constructed on or after April 1, 1973 which meets the following specifications or their equivalent as determined by the commissioner:

(1) Walls, floors and ceilings constructed of at least eight inches of reinforced concrete or other substantial masonry, reinforced vertically and horizontally with one-half inch steel rods tied six inches on center, or the structural equivalent to such reinforced walls, floors and ceilings.

(2) The door of the vault shall contain a multiple position combination lock or the equivalent, a relocking device or equivalent and steel plate with a thickness of at least one-half inch. (The GSA Class 5 rated steel door meets all of the qualifications for the vault door.)

(3) The vault, if operations require it to remain open for frequent access shall be equipped with a "day gate" or the equivalent, which is self closing and self-locking. If the operation requires only that the vault be opened infrequently, such as to remove raw material in the morning and return raw material at night, and is always relocked immediately after use, a "day gate" is not required.

(4) The walls or perimeter of the vault shall be equipped with a tamper-proof closed circuit alarm approved by Underwriter's Laboratories which, when unauthorized entry is attempted, transmits a signal directly to a central station protection company, a local police agency which has a legal duty to respond or a 24-hour control station operated by the registrant. If necessary, due to local conditions or other problems, holdup buttons shall be placed at strategic points of entry to the perimeter area of the vault.

(5) The vault door shall be equipped with a contact switch.

(6) The vault shall have one of the following:

(i) complete electrical lacing of the walls, floor and ceiling;
(ii) sensitive ultrasonic equipment within the vault;
(iii) sensitive sound accumulator system; or
(iv) such other device designated to detect illegal entry as may be approved by the department.

1.3 SUBMITTALS

A. Certification: submit written certification that the vault door and day gate meet the requirements in section 1.2 and that the vault door is a GSA Class 5 door.

B. Shop Drawings: Vault door and day gate showing size, material, finish and relation to adjacent construction.

C. Manufacturer's Literature and Data:

1. All information for Vault door and day gate including hardware
2. Installation instructions.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. Federal Specifications (Fed. Spec.):

AA-D-00600C.....Door, Vault, Security

FF-L-2740 .....Locks, Combination

PART 2 - PRODUCTS

2.1 VAULT DOOR

A. Overly Door Company model # C5V-IIR-K, Class 5 Vault Door and Assembly, Right Swing with Optical Device. Include installation, as well as all required components for a successful door installation including hardware and threshold. Confirm requirements with requirements listed in 1.2:

The door of the vault must contain a multiple position combination lock (or equivalent), a relocking device (or equivalent) and steel plate with a thickness of at least one-half inch (e.g., GSA Class 5 rated steel door) … The vault must have a device designated to detect illegal entry and the vault door must be equipped with a contact switch.

B. Add to standard spec: electric strike, modification of frame to allow for supply of power to electric strike

2.3 VAULT DAY GATE

A. Overly Door Vault Day Gate #C5V-DG, coordinated with frame and operation of Vault Door. Include installation, as well as all required components for a successful door installation including hardware and threshold. Confirm requirements with requirements listed in 1.2:

Vaults that remain open for frequent access must be equipped with a “day gate” (or equivalent), which is self-closing and self-locking.

B. Add to standard spec: self-closing and self-locking, electric strike, modification of frame to allow for supply of power to electric strike

2.4 MANUFACTURER: (limited to this one manufacturer)

A. Overly Door Company (www.overly.com)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install vault door and day gate in accordance with manufacturer's printed installation instructions and approved shop drawings.
B. Use a certified installer of this product from the link on the Overly website: https://door.overly.com/certified-installers
C. Review operation and maintenance of door with facility, obtain approval of facility and A/E of installation.

3.2 WARRANTY

A. Extended 5-year warranty.

End Section 083459

SECTION 084110: FIXED ALUMINUM-FRAMED WINDOWS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section covers Kawneer Fixed Aluminum-Framed Windows, including perimeter trims, sills. stools, accessories, shims and anchors, and perimeter sealing of Window units.

B. Types of Kawneer Fixed Aluminum-Framed Windows include:
   1. Trifab® 451UT Framing System:
      a. 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension
      b. Thermal
      c. Center Plane
      d. Screw Spline Fabrication

C. Related Sections:
   1. 084113: Aluminum-Framed Entrances
   2. 088000: Glazing

1.3 DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.4 PERFORMANCE REQUIREMENTS

A. General Performance:
   1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of aluminum Window systems representing those indicated for this project.
   2. Aluminum Window systems shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   3. Failure includes any of these events:
      a. Thermal stresses transferring to building structure
      b. Glass breakage
      c. Loosening or weakening of fasteners, attachments, and other components
      d. Failure of operating units

B. Delegated Design:
   1. Design aluminum Window systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads:
   1. The system shall include anchorage that is capable of withstanding the following wind load design pressures:
      a. Wind Load
         1) 1. Design for maximum allowable system deflection, normal to the plane of the wall, of L/240.
         2) Maximum wind load resistance: 55 PSF, provided structural supports and sheathing/sheathing attachment are adequate to resist these pressures

D. Air Leakage:
   1. The test specimen shall be tested in accordance with ASTM E 283.
   2. With interior seal, air leakage rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s · m^2) at a static air pressure differential of 6.2 psf (300 Pa).
   3. Without interior seal, air leakage rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s · m^2) at a static air pressure differential of 1.6 psf (75 Pa).
   4. CSA A440 Fixed Rating

E. Water Resistance:
   1. The test specimen shall be tested in accordance with ASTM E 331.
   2. There shall be no leakage at a minimum static air pressure differential of 10 psf (479 Pa) as defined in AAMA 501.

F. Uniform Load:
   1. A static air design load of 40 psf (1436 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330.
   2. There shall be no deflection in excess of L/175 of the span of any framing member.
   3. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

G. Seismic:
   1. When tested to AAMA 501.4, system must meet design displacement (elastic) of 0.010 x the story height and ultimate displacement (inelastic) of 1.5 x the design displacement.

H. Thermal Movements:
   1. Allow for thermal movements resulting from the following:
      a. 0°F (-18 C) to 180°F (82 C) maximum change (range) in ambient and surface temperatures
      b. 75°F (24 C) test interior ambient air temperature

2. Test performance shows no buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5 for a minimum 3 cycles.

I. Thermal Transmittance (U-factor):
   1. Thermal transmittance test results are based upon 1" (25.4 mm) clear high-performance insulating glass [1/4" (e=0.035, #2), 1/2" warm edge spacer and argon fill gas, 1/4"].
   2. When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than: .32 (HP glass)

J. Condensation Resistance Factor (CRF) or Condensation Index (CI):
   1. If using CRF: When tested to AAMA Specification 1503, the CRF shall not be less than 68_{frame} and 68_{glass} (low-e).
   2. If using CI: When tested to CSA A-440, the CI shall not be less than 60_{frame} and 62_{glass} (low-e).

K. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC):
   1. Sound transmission loss test results in accordance with AAMA 1801 are based upon 1" (25.4 mm) clear double laminated insulating glass with PVB interlayer (1/8", 0.030", 1/8", 1/2" AS, 1/8", 0.030", 1/8").
   2. Ratings shall not be less than STC 37 and OITC 30.

L. Environmental Product Declaration (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.

M. Material Ingredient Reporting:
   1. Shall have a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
   2. Acceptable documentation includes:
      a. Manufacturer's inventory with Chemical Abstract Service Registration Number (CASRN or CAS#):
         1) Kawneer's Material Transparency Summary (MTS)
      b. Cradle to Cradle certification; either document listed below is acceptable for this option:
         1) Cradle to Cradle Certified™ with Material Health section Silver or higher
         2) Silver Level or higher Material Health Certificate

1.5 SUBMITTALS

A. Product Data:
   1. For each type of window indicated, include:
      a. Construction details
      b. Material descriptions
      c. Dimensions of individual components and profiles
      d. Hardware
      e. Finishes
      f. Installation instructions
      g. Rule.
   2. Material Ingredient Reporting

B. Shop Drawings:
   1. Plans
   2. Elevations
   3. Sections
   4. Details
   5. Hardware
   6. Attachments to other work
   7. Operational clearances
   8. Installation details

C. Samples for Initial Selection:
   1. Provide samples for units with factory-applied color finishes.
   2. Provide samples of hardware and accessories involving color selection.

D. Samples for Verification:
   1. Provide a verification sample for aluminum-framed Window system and required components.

E. Product Test Reports:
   1. Provide test reports for each type of aluminum-framed Window used in the project.
   2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
   3. Test reports must indicate compliance with performance requirements.

F. Fabrication Sample:
   1. Provide a fabrication sample of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
      a. Joinery, including concealed welds
      b. Anchorage
      c. Expansion provisions

d. Glazing
e. Flashing and drainage

G. Entrance Door Hardware Schedule: (not used in this section)
1. Schedule shall be prepared by or under the supervision of supplier.
2. Schedule shall detail fabrication and assembly of entrance door hardware, including procedures and diagrams.
3. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer must have successfully installed the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:
1. Manufacturer must be capable of providing aluminum-framed Window systems that meet or exceed performance the stated performance requirements.
2. Manufacturer must document this performance by the inclusion of test reports and calculations.

C. Source Limitations:
1. Obtain aluminum-framed Window system through one source from a single manufacturer.

D. Product Options:
1. Drawings indicate size, profiles, and dimensional requirements of aluminum-framed Window system and are based on the specific system indicated. Refer to Division 01 Product Requirements Section. Do not modify size and dimensional requirements.
2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups:
1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
2. Build mockups for the type(s) of Window elevation(s) indicated, in location(s) shown on drawings.

F. Pre-installation Conference:
1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

G. Structural-Sealant Glazing must comply with ASTM C 1401, “Guide for Structural Sealant Glazing” for design and installation of structural-sealant-glazed systems.

H. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

1.7 PROJECT CONDITIONS

A. Field Measurements:
1. Verify actual dimensions of aluminum-framed Window openings by field measurements before fabrication.
2. Indicate measurements on shop drawings.

1.8 WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:
1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product:
1. Kawneer Company, Inc.
2. Trifab® 451UT Framing System:
a. 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension
b. Thermal
c. Center Plane
d. Screw Spline Fabrication

B. Substitutions:
1. None
2. Pre-Contract (Bidding Period) Substitutions:
a. Submit written requests ten (10) days prior to bid date.
3. Post-Contract (Construction Period) Substitutions:
a. Submit written request in order to avoid installation and construction delays.
4. Product Literature and Drawings:
a. Submit product literature and drawings modified to suit specific project requirements and job conditions.
5. Certificates:
a. Submit certificate(s) certifying that the substitute manufacturer (1) attests to adherence to specification requirements for Window system performance criteria, and (2) has been engaged in the design, manufacture, and fabrication of aluminum Windows for a period of not less than ten (10) years. (*Company Name*)
6. Test Reports:
a. Submit test reports verifying compliance with each test requirement required by the project.

7. Samples:
   a. Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

C. Substitution Acceptance: None on this project

2.2 MATERIALS

A. Aluminum Extrusions:
   1. Alloy and temper recommended by aluminum Window manufacturer for strength, corrosion resistance, and application of required finish
   2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame
   3. Complying with ASTM B221: 6063-T6 alloy and temper

B. Fasteners:
   1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories:
   1. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

D. Reinforcing Members:
   1. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.

E. Sealant:
   1. For sealants required within fabricated Window system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
   2. Tolerances:
   3. References to tolerances for wall thickness and other cross-sectional dimensions of Window members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 WINDOW FRAMING SYSTEM

A. Thermal Barrier:
   1. Kawneer DUAL Isolock® Thermal Break with two (2) 1/4" (6.4 mm) separations consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum Window sections.
   2. Thermal break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

B. Brackets and Reinforcements:
   1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

C. Fasteners and Accessories:
   1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
   2. Where exposed, fasteners and accessories shall be stainless steel.

D. Perimeter Anchors:
   1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

E. Packing, Shipping, Handling, and Unloading:
   1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

F. Storage and Protection:
   1. Store materials so that they are protected from exposure to harmful weather conditions.
   2. Handle material and components to avoid damage.
   3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.4 GLAZING SYSTEMS

A. Glazing to meet requirements in Division 08 Glazing Section.

B. Glazing Gaskets:
   1. Manufacturer's standard compression types
   2. Replaceable, extruded EPDM rubber

C. Spacers and Setting Blocks:
   1. Manufacturer's standard elastomeric type

D. Bond-Breaker Tape:
   1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing sealants as recommended by manufacturer for joint type, and as follows:
   1. Weatherseal sealant:
      a. ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O
      b. Single-component neutral-curing formulation that is compatible with the structural sealant and other system components with which it comes in contact
      c. Recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use
      d. Color: Matching structural sealant

2.5 ACCESSORY MATERIALS

A. Joint Sealants:

1. For installation at perimeter of aluminum-framed systems, as specified in Division 07 Joint Sealants Section.

B. Bituminous Paint:
1. Cold-applied asphalt-mastic paint
2. Complies with SSPC-Paint 12 requirements except containing no asbestos
3. Formulated for 30-mil (0.762 mm) thickness per coat

2.6 FABRICATION

A. Fabricate framing member components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations
2. Accurately fitted joints that are flush, hairline, and weatherproof
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior
4. Physical and thermal isolation of glazing from framing members
5. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances
6. Provisions for field replacement of glazing
7. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible

B. Mechanically Glazed Framing Members:
1. Fabricate for flush glazing without projecting stops.

C. Window Framing used to create sidelight adjacent to NX8910 Terrace doors and fixed windows:
1. Fabricate components for assembly using manufacturer’s standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

2.7 ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
1. Kawneer Permanodic® AA-M10C21A41 / AA-M45C22A41, AAMA 611, Architectural Class I Clear Anodic Coating #29 Black anodized-confirm with architect.

PART 3 EXECUTION

3.1 EXAMINATION

A. With installer present, examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work:

1. Verify rough opening dimensions.
2. Verify levelness of sill plate.
3. Verify operational clearances.
4. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components for proper water management.
5. Masonry Surfaces:
   a. Masonry surfaces must be visibly dry and free of excess mortar, sand, and other construction debris.
6. Wood Frame Walls:
   a. Wood frame walls must be dry, clean, sound, well nailed, free of voids, and without offsets at joints.
   b. Ensure that nail heads are driven flush with surfaces in opening and within 3" (76.2 mm) of opening.
7. Metal Surfaces:
   a. Metal surfaces must be dry and clean (free of grease, oil, dirt, rust, corrosion, and welding slag).
   b. Ensure that metal surfaces are without sharp edges or offsets at joints.

B. Proceed with installation only after correcting unsatisfactory conditions.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed Window system, accessories, and other components.

B. Install aluminum-framed window system so that components:
1. Are level, plumb, square, and true to line
2. Are without distortion and do not impede thermal movement
3. Are anchored securely in place to structural support
4. Are in proper relation to wall flashing and other adjacent construction

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather-tight construction.

D. Install aluminum-framed Window system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed Window system to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
1. Architect shall select Window units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured.
2. Conduct tests for air infiltration and water penetration with manufacturer’s representative present.

3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
4. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
5. Air Infiltration Tests:
   a. Conduct tests in accordance with ASTM E 783.
   b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft^2, whichever is greater.
6. Water Infiltration Tests:
   a. Conduct tests in accordance with ASTM E 1105.
   b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).

B. Manufacturer's Field Services:
1. Upon owner’s written request, provide periodic site visit by manufacturer’s field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:
1. Protect installed product’s finish surfaces from damage during construction.

C. Cleaning:
1. Clean glass immediately after installation.
   a. Comply with glass manufacturer's written recommendations for final cleaning and maintenance.
   b. Remove non-permanent labels and clean surfaces.
2. Clean aluminum surfaces.
3. Avoid damaging protective coatings and finishes.
4. Remove excess sealants, glazing materials, dirt, and other substances.
5. Repair or replace damaged installed products.
6. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
7. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 084110

NOTES AND DISCLAIMERS

Laws and building and safety codes governing the design and use of Kawneer products, such as glazed entrance, window, and curtain wall products, vary widely. Kawneer does not control the selection of product configurations, operating hardware, or glazing materials, and assumes no responsibility therefor. It is the responsibility of the owner, the specifier, the architect, the general contractor, and the installer and the fabricator/transformer, consistent with their roles, to determine the appropriate materials for a project in strict conformity to all applicable national, regional and local building codes and regulations.

Kawneer reserves the right to change configuration without prior notice when deemed necessary for product improvement.

Information contained herein or related hereto is intended only for evaluation by technically skilled persons, with any use thereof to be at their independent discretion and risk. Such information is believed to be reliable, but Kawneer shall have no responsibility or liability for results obtained or damages resulting from such use.

This guide specification is intended to be used by a qualified construction specifier. The guide specification is not intended to be used verbatim as a project specification without appropriate modifications for the specific use intended. The guide specification must be used and coordinated with the procedures of each design firm and the particular requirements of a specific construction project.

Kawneer grants no license under, and shall have no responsibility or liability for infringement of, any patent or other proprietary right. Nothing in this document should be construed as a warranty or guarantee by Kawneer, and the only applicable warranties will be those set forth in Kawneer acknowledgment or in any printed warranty documents issued by Kawneer. The foregoing may be waived or modified only in writing by a Kawneer officer.

084113-ALUMINUM-FRAMED ENTRANCES

Part 1: General

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Summary

A. Section Includes: Kawneer Aluminum Entrances, glass and glazing, and door hardware and components.
   1. Types of Kawneer Aluminum Entrances include:
      a. NX-8910 Terrace Doors **(Outswing)** 2-3/4" (69.8) depth, installed/anchored to adjacent to TriFab 451UT storefront sidelite(s). See contract drawings
         1) AW-PG50-ATD – Single (Standard Sill)
         2) Section applies to one opening: Opening 301

B. Related Sections:
   1. 079200 “Joint Sealants”
   2. 084313 "Aluminum-Framed Storefronts"
   3. 088000 “Glazing”

1.3 Definitions

A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufactures Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 Performance Requirements

A. General Performance: Comply with performance requirements specified, as determined by testing of glazed terrace doors representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Terrace Door Entrance Performance Requirements:
   1. Provide aluminum terrace doors of performance indicated that comply with AAMA/WDMA/CSA 101/I.S.2/A440 (NAFS).
   2. Performance Class and Grade: AW-PG50-ATD.

C. Air Infiltration: Outswing Doors: When closed and locked, the test specimen shall be tested in accordance with ASTM E 283 entrance doors and frame shall not exceed 0.10 cfm/ft^2 (Inswing), 0.40 cfm/ft^2 (Outswing) at a pressure differential of 6.24 psf (300 Pa).

D. Water Resistance: When closed and locked, the test specimen shall be tested in accordance with ASTM E 331 and ASTM E 547 there shall be no uncontrolled leakage as defined in the test method at a static air pressure differential of **(Outswing - Standard Sill), 12 psf** (574 Pa)

E. Uniform Design Load Test: When closed and locked, the test specimen shall be tested in accordance with ASTM E 330 at a minimum static air design pressure of:

   1. NX-8910 Terrace Doors (Outswing).
      a. AW-PG50-ATD – Single (Standard Sill) 50 psf (2394 Pa) applied in a positive and negative direction.

F. Uniform Load Structural Test: When closed and locked, the test specimen shall be tested in accordance with ASTM E 330 at a minimum static air design pressure of:

1. NX-8910 Terrace Doors (Outswing).
   a. AW-PG50-ATD – Single (Standard Sill) 75 psf (3591 Pa) (1.5 x design load) applied in a positive and negative direction.

G. Thermal Transmittance Test (U-Factor): When tested in accordance with AAMA 1503, the conductive thermal transmittance (U-Factor) shall not be more than 0.42 BTU/hr/ft^2/F. using.24 CoG glass

H. Condensation Resistance Test (CRF): When tested in accordance with AAMA 1503, the condensation resistance factor (CRF) shall not be less than 60_{frame}, 78_{glass}.

I. Forced Entry Resistance: Terrace Doors shall conform to ASTM F588, Grade 10.

1.5 Submittals

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum terrace door and frame system indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.

C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.

D. Samples for Verification: For aluminum terrace door and frame system and components required.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type, of aluminum terrace door and frame.

F. Fabrication Sample: Corner sample consisting of a door stile and rail, of full-size components and showing details of the following:
1. Joinery, showing mitered, clip and stake joint construction.
2. Glazing.

G. Other Action Submittals:
1. Terrace Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of terrace door hardware, as well as procedures and diagrams. Coordinate final terrace door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of terrace door hardware.

1.6 Quality Assurance

A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum terrace doors and frames that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

C. Source Limitations: Obtain aluminum terrace doors and frames through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum terrace doors and frames, and are based on the specific system indicated. Refer to Division 01 Section “Product Requirements”. Do not modify size and dimensional requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.7 Project Conditions

A. Field Measurements: Verify actual dimensions of aluminum terrace door and frame openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

1.8 Warranty

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
   1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Basis-of-Design Product:
   1. Kawneer Company Inc.
   2. NX-8910 Terrace Doors – Outswing.
   3. Entrance Member Profile: 4.125" (104.7) nominal face dimension, 2-3/4" (69.8) depth, moderate traffic applications.
   4. 3-1/4" (82.5) or 4-5/8" (117.5) frame depth.

2.2 Materials

A. Aluminum (Terrace Door and Components): Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
   1. Extruded Material Standard: ASTM B 221, 6063-T6 alloy and temper.

B. Glazing Gaskets / Setting Blocks: Manufacturer's standard glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements.

C. Fasteners: Where exposed, shall be 300 Series, Stainless Steel.

D. Weather Stripping: Hollow black thermoplastic elastomer (TPE) bulb gasket with rigid polypropylene backing.

E. Thermal Barrier: Shall be two continuous rows of polyamide glass reinforced 6/6 nylon at door rails, door stiles and frame.

2.3 Terrace Door Framing System

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.

B. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

C. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle terrace door and frame material, and components to avoid damage. Protect terrace door and frame material against damage from elements, construction activities, and other hazards before, during and after terrace door and frame installation.

2.4 Glazing

A. Glass and Glazing Materials: Refer to Division 08 Section “Glazing” for glass units and glazing requirements applicable to glazed aluminum window units.

B. Glazing System: Glazing method shall be a wet/dry type in accordance with manufacturer’s standards. Glazing shall be silicone back bedding sealant and snap-in type glazing beads with a gasket in accordance with AAMA 702 or ASTM C864.

2.5 Hardware

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and secure aluminum terrace doors and frames.

B. Standard Entrance Hardware: Provide heavy-duty hardware units indicated in sizes, number and type recommended by manufacturer for entrances indicated. Finish exposed parts to match door finish, unless otherwise indicated.

C. Hinges:
1. Butt Hinges: Provide manufacturer’s standard mortised, top, bottom and intermediate aluminum 3-way adjustable butt hinges.

D. Door Control:
1. Overhead Door Stop: Shall be stainless steel with rubber bumper door check mounted in the top rail of the door leaf.

E. Standard Locking Hardware:
a. Singles (Outswing):
Active Leaf: Stainless steel 5-point locking gearbox consisting of roundbolts, latch lock, dead bolt, and shootbolts activated by a lever

Singles: Key exterior / thumbturn interior.

Trim Set Finish:

1. Polished Chrome

F. Thresholds: Provide manufacturer's standard thermally broken threshold, cutouts coordinated for operating hardware, and anchors in the following material.
1. Material: Aluminum, finish to match door and frame.

2.6 Fabrication

A. Entrance System Fabrication:
1. Door corner construction shall be neatly mitered and reinforced with heavy-duty aluminum corner blocks forming a rigid watertight joint. Corners shall be crimped.
2. Accurately fit and secure joints and corners. Make joints hairline in appearance.
3. Arrange fasteners and attachments to conceal from view.

2.7 Aluminum Finishes

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Kawneer Permanodic™ AA-M10C21A41 / AA-M45C22A41, AAMA 611, Architectural Class I Clear Anodic Coating Color #14 Clear anodized

PART 3 - EXECUTION

3.1 Examination

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight terrace door and frame installation.
   1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
   2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76.2 mm) of opening.
   3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum terrace doors and frames, hardware, accessories, and other components.

B. Install aluminum terrace doors and frames level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill threshold in bed of sealant, as indicated, for weather tight construction.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 Field Quality Control

A. Manufacturer's Field Services: Upon Owner’s written request, provide periodic site visit by manufacturer’s field service representative.

3.4 Adjusting, Cleaning, and Protection

A. Clean aluminum surfaces immediately after installing terrace doors and frames. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

DISCLAIMER STATEMENT

This guide specification is intended to be used by a qualified construction specifier. The guide specification is not intended to be verbatim as project specification without appropriate modifications for the specific use intended. The guide specification must be used and coordinated with the procedures of each design firm, and the particular requirements of a specific construction project.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.

C. Related Sections:

1. Division 06 Section “Rough Carpentry”.
2. Division 06 Section “Finish Carpentry”.
3. Division 08 Section “Hollow Metal Doors and Frames”.
4. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check

Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Twenty five years for manual overhead door closer bodies.
3. Two years for electromechanical door hardware, unless noted otherwise.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

   a. Bommer Industries (BO).
   b. Hager Companies (HA).
   c. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) - EL-CEPT Series.
b. Securitron (SU) - EL-CEPT Series.
c. Von Duprin (VD) - EPT-10 Series.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

a. Hager Companies (HA) - Quick Connect.
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

a. Door Controls International (DC).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3).
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

F. Construction Keying: Provide construction master keyed cylinders.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. No Substitution.

2.7 ELECTROMECHANICAL LOCKING DEVICES

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 ELECTRIC STRIKES

A. Standard Electric Strikes: Electric strikes tested to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

a. HES (HS) - 1500/1600 Series.

B. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.10 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC8000 Series.
b. LCN Closers (LC) - 4040 Series.
c. Norton Door Controls (NO) - 7500 Series.
d. Sargent Manufacturing (SA) - 351 Series.

2.11 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Rixson Door Controls (RF).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Sargent Manufacturing (SA).

2.12 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.13 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. RO - Rockwood
3. RU - Corbin Russwin
4. HS - HES
5. RF - Rixson
6. NO - Norton
7. OT - Other
8. PE - Pemko
9. SA - SARGENT
10. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 200

3 Hinge, Full Mortise	TA2714	US26D	MK
3 Hinge, Spring	1502 4-1/2" x 4-1/2"	US26D	MK

1	Flush Bolt	2845	US26D	RO	
1	Dust Proof Strike	570	US26D	RO	
1	Fail Safe Lock	ML20606 x NAC-SAF LWA LC	630	RU	⚡
2	Cylinder	Compatible with Facility'sExisting System	626		
1	Coordinator	NX2600 Series x Mtg. Brkts. & Wear Plates As Required	Black	RO	
1	Door Closer	7500 / P7500	689	NO	
2	Door Stop	RM850 / RM860	US26D	RO	
2	Silencer	608		RO	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	⚡
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	⚡
1	Wiring Diagram	WD-SYSPK		SA	
1	Card Reader	by Security System Supplier		OT	
1	Power Supply	AQD6		SU	⚡
2	Electric Power Transfer	EL-CEPT		SU	⚡

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

Set: 2.0

Doors: 211

6	Hinge, Full Mortise	TA2714	US26D	MK	
2	Dust Proof Strike	570	US26D	RO	
2	Flush Bolt	555	US26D	RO	
1	Fail Secure Lock	ML20606 x NAC-SEC LWA LC	630	RU	⚡
2	Cylinder	Compatible with Facility'sExisting System	626		
1	Automatic Operator	by Specification Section 087113		OT	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	⚡
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	⚡
1	Wiring Diagram	WD-SYSPK		SA	
2	Operator Paddle	by Specification Section 087113		OT	
1	Card Reader	by Security System Supplier		OT	
1	Power Supply	AQD6		SU	⚡
2	Electric Power Transfer	EL-CEPT		SU	⚡

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position

switches, activates outside operator paddle & allows for authorized entrance. Operating inside touchpad or inside operator paddle activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 3.0

Doors: 212

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Fail Secure Lock	ML20606 x NAC-SEC LWA LC	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK
1	Wiring Diagram	WD-SYSPK		SA
1	Card Reader	by Security System Supplier		OT
1	Power Supply	AQD6		SU
1	Electric Power Transfer	EL-CEPT		SU

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

Set: 4.0

Doors: 217

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Storeroom Lock	ML2057 LWA LC	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 5.0

Doors: 205A

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Entrance Lock	ML2054 LWA LC	630	RU

1	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 6.0

Doors: 213

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Classroom Lock	ML2055 LWA LC	630	RU
2	Cylinder	Compatible with Facility'sExisting System	626	
2	Door Stop	RM850 / RM860	US26D	RO
2	Silencer	608		RO

Set: 7.0

Doors: 201

6	Hinge, Full Mortise	TA2714	US26D	MK
2	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Classroom Lock	ML2055 LWA LC	630	RU
2	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Closer	7500 / P7500	689	NO
2	Door Stop	RM850 / RM860	US26D	RO
2	Silencer	608		RO

Set: 8.0

Doors: 215

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Classroom Lock	ML2055 LWA LC	630	RU
2	Cylinder	Compatible with Facility'sExisting System	626	
1	Electric Strike	1600-CLB	630	HS
1	Automatic Operator	by Specification Section 087113		OT
1	ElectroLynx Harness - Frame	QC-C1500P		MK
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK

1	Wiring Diagram	WD-SYSPK		SA
2	Operator Paddle	by Specification Section 087113		OT

Set: 9.0

Doors: 203, 207

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	ML2055 LWA LC	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 10.0

Doors: 206, 216

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	ML2055 LWA LC	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Conc Overhead Stop	1-X36	630	RF
3	Silencer	608		RO

Set: 11.0

Doors: 205, 214

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Classroom Lock	ML2055 LWA LC	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 12.0

Doors: 209

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	ML2068 LWA V21	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 13.0

Doors: 204

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Privacy Lock	ML2068 LWA V21	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Door Closer	7500 / P7500	689	NO
1	Door Stop	RM850 / RM860	US26D	RO
3	Silencer	608		RO

Set: 14.0

Doors: 211A, 211B, 211C

6	Hinge, Full Mortise	TA2714	US26D	MK
1	Dust Proof Strike	570	US26D	RO
2	Flush Bolt	555	US26D	RO
1	Push Pull	111x73C/73CL	US32D	RO
1	Automatic Operator	by Specification Section 087113		OT
2	Door Stop	RM850 / RM860	US26D	RO
2	Silencer	608		RO
2	Operator Paddle	by Specification Section 087113		OT

Set: 15.0

Doors: 208A, 208B

1	All Hardware	by Assembly Supplier		OT

Set: 16.0

Doors: 301

3	Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1	Dormitory Lock	ML2065 LWA LC	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
1	Threshold	253x3AFG MSES25SS-2		PE
1	Gasketing	290APK x 2891APK		PE
1	Door Bottom	420APKL		PE

Notes: Opening cannot be locked on the roof side.

Set: 17.0

Doors: 302

3	Hinge, Full Mortise, Hvy Wt	T4A3386	US32D	MK
1	Storeroom Lock	ML2057 LWA LC	630	RU
1	Cylinder	Compatible with Facility'sExisting System	626	
1	Conc Overhead Stop	1-X36	630	RF
1	Door Closer	7500 / P7500	689	NO
1	Threshold	253x3AFG MSES25SS-2		PE
1	Gasketing	290APK x 2891APK		PE
1	Door Bottom	420APKL		PE

END OF SECTION 087100

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. This Section includes the following:
1. Power-operating door operators.
2. Touchless Wave Switch
3. Interconnecting door controls (to create relationship between pairs of doors where only one door in the pair can be open at a time) for Doors 211 and 211A.
4. Basis of Design: Stanley Access Technologies; Div. of The Stanley Works (Aaron M. LeClere - Territory Manager Eastern NY – Western MA - O: 518-618-1999 * C:518-221-8316 * Aaron.Leclere@sbdinc.com)

Dr	Type	Hard-ware Type	BEA Touch-less Wave Switch-MS41 Single	Camden EMF-2 Wall Box with transformer (less than 15' from door)	Stanley M-Force Single panel operator	Camden EMF-2 Interlock	Card Reader (see MEP specs)
200	Main Entrance into Pharmacy			√			√
208b	Day Gate into Vault						√
211	Double Door - Pharmacy to Vestibule		√ x 2		√	√	
211a	Double Door - Vestibule to Anteroom		√ x 2		√	√	
215	Double Door – Corridor to Work Area		√ x 2		√		

Touchless Wave Switch MS41C	https://documentcloud.adobe.com/link/track?uri=urn:aaid:scds:US:9e4e206b-7485-4d43-8d93-55e8ea7e9425
Stanley M- Force	https://documentcloud.adobe.com/link/track?uri=urn:aaid:scds:US:54ccefe5-dac9-4d6e-88a6-ae4a59514706
.	
Camden EMF-2 Interlock	https://documentcloud.adobe.com/link/track?uri=urn:aaid:scds:US:4e0e3c5a-4e23-42a6-bcd0-f8f2be742e55
Power Location – Uneven Pair	https://documentcloud.adobe.com/link/track?uri=urn:aaid:scds:US:d65fd168-db75-4c42-a667-aedff4941143
Card Reader	(See MEP specs)

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for metal guide rails for doors equipped with power door operators.
   2. Division 08 door Sections for doors that need reinforcement for automatic door operators.
   3. Division 08 Section "Finish Hardware" for door hardware that must be coordinated with automatic door operator fire-door package.
   4. Division 26 Sections for electrical connections including conduit and wiring for automatic door operators.
   5. Division 28 Sections for building security data connections including conduit and wiring for automatic door operators.

1.4 DEFINITIONS

A. Activation Device: Device that, when actuated, sends electrical signal to automatic door operator to open door.

1.5 PERFORMANCE REQUIREMENTS

A. Opening and Closing Forces: Not more than 15 lbf (67 N applied) 1 inch (25 mm) from the latch edge of the door.

1.6 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators and activation and safety devices.

B. Shop Drawings: Show fabrication and installation details for automatic door operators. Include locations and elevations of entrances showing activation devices.

C. Samples for Initial Selection: For each type of exposed component and door control indicated.

D. Samples for Verification: For exposed components and activation and safety devices with factory-applied color finishes.

E. Qualification Data: For Installer, manufacturer, and testing agency.

F. Field quality-control test reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

H. Operation and Maintenance Data: For automatic door operators to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project, and who employs an inspector certified by AAADM.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer Qualifications: Company certificate issued by AAADM.

C. Testing Agency Qualifications: An independent agency with inspector certified by AAADM.

D. Source Limitations: Obtain automatic door operators through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. UL Standard: Comply with UL 325.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify door openings by field measurements before fabrication of exposed covers for automatic door operators and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate size and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing automatic door operators. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.

C. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies and security access control system.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Faulty or sporadic operation of automatic door operator or activation and safety devices.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
2. Warranty Period: Two years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Maintenance: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of automatic door operator Installer. Include semi-annual planned

and preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Engage inspector certified by AAADM to perform safety inspection after each adjustment or repair and at end of maintenance period. Submit completed inspection form to Owner.
2. Perform maintenance, including emergency callback service, during normal working hours.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service.

1.12 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Activation and Safety Devices: One unit of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (no other manufacturers are acceptable):
1. Basis of Design: Stanley Access Technologies; Stanley M Force Operator
2. Alternative: Besam Automated Entrance Systems, Inc.
3. Alternative: Horton Automatics.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with standards indicated below:
1. Sheet: ASTM B 209 (ASTM B 209M).
2. Extrusions: ASTM B 221 (ASTM B 221M, Alloy 6063-T5 or T-6).

B. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

2.3 AUTOMATIC DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
1. Where indicated for center-pivoted doors, provide emergency breakout feature for reverse swing of doors.
2. Provide door operators that comply with NFPA 80 requirements for doors as emergency exits and that do not interfere with fire ratings.

B. Electromechanical Operating System: Unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, and with manual operation including spring closing with power off.

C. Hinge Operation: Refer to Division 08 Section "Door Hardware" to determine type of hinge for each door that door operator shall accommodate.

D. Housing: Fabricated from 0.125-inch- (3.2-mm-) thick extruded or formed aluminum.

E. Exposed Cover: Fabricated from 0.125-inch- (3.2-mm-) thick extruded aluminum; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.
1. Finish: Match door and frame.
2. Color: As selected by Architect from manufacturer's full range.

F. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution labels for fire-resistance-rated doors.
1. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-safe design.
2. Equip system to discontinue power to automatic door operator when door is in emergency breakout position, and to return to closed position after breakout and automatically reset.

2.4 LOW-ENERGY, POWER-OPERATING DOOR OPERATORS

A. Standard: Comply with BHMA A156.19.

B. Performance Requirements:
1. Not more than 15 lbf (67 N applied)1 inch (25 mm) from latch edge of door to prevent stopped door from opening or closing.
2. If power fails, not more than 30 lbf (133 N applied)1 inch (25 mm) from latch edge of door to manually set door in motion.

C. Operation: Power opening and power-assisted spring closing.
1. Power-Assisted Opening: Power-assisted opening that reduces force to open self-closing door. Pushing or pulling on door activates automatic door operator.

D. Operating System: Electromechanical.

E. Microprocessor Control Unit: Solid-state controls.

F. Features:
1. Adjustable opening and closing speed.
2. Adjustable opening force.
3. Adjustable backcheck.
4. Adjustable hold-open time of not less than 0 to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Obstruction recycle.

G. Mounting: Surface.

2.5 ACTIVATION AND SAFETY DEVICES

A. Wall Wave-Plate Switch: Manufacturer's standard semiflush, wall-mounted, door control switch; consisting of rectangle face plate, stainless wave plate; of material indicated; and actuator mounted in recessed junction box. Provide engraved message as indicated. text
1. Material: Stainless steel.
2. Message: International symbol of accessibility and "Push to Open."

B. By Others - Proximity Card Reader: Manufacturer's standard recess-mounted, 4-by-4-inch (100-by- 100-mm) door control switch, with card reader interlocked with building security system. Refer to Division 28 Sections.
   1. Accessory: Card encoder and software.
   2. Card: Manufacturer's standard 0.030-inch-thick PVC or polyester.

C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.6 ACCESSORIES

A. Low-Energy Automatic Door Operator Signage: Comply with BHMA A156.19.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame supports, and other conditions affecting performance of automatic door operators.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install complete automatic door operator system, including activation and safety devices, control wiring, and remote power units.

B. Low-Energy Power Door Operator Installation Standard: Comply with BHMA A156.19 for installation.

C. Automatic Door Operators: Install door operator system, including control wiring, as follows:
1. Refer to Division 26 Sections for connection to electrical power distribution system.

2. Touchless wave plates on both sides of each opening indicated to receive automatic door operators.

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: After installation has been completed, testing and inspecting of each automatic door operator shall be performed to verify compliance with applicable BHMA standards.
1. Inspection Report: Submit report in writing to Architect and Contractor within 24 hours after inspection.

C. Remove and replace automatic door operators where test results indicate they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING

A. Adjust automatic door operators and activation and safety devices to operate smoothly, easily, and properly, and for safe operation and weathertight closure.
1. Adjust doors with low-energy door operators to close according to BHMA A156.19.

B. Lubricate operators, hardware, and other moving parts.

C. After completing installation of exposed, factory-finished automatic door operators, inspect exposed finishes and repair damaged finishes.

D. Readjust automatic door operators and activation and safety devices after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles). Lubricate hardware, operating equipment, and other moving parts.

E. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this

purpose, without additional cost.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative or manufacturer's inspector certified by AAADM to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators. Refer to Division 01 Section "Demonstration and Training."

End of Section 087113

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Interior borrowed lites
2. Fixed Aluminum-Framed Windows
3. Aluminum-Framed Entrances (opening 301 only)

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 and ICC's 2003 International Building Code by a qualified professional engineer, using the following design criteria:

1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

a. Wind Speed: 110 mph
b. Exposure Category: B
c. Importance Class: III

d. Importance Factor: 1.15

2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. “U” Value - Aluminum Windows:

1. Thermal transmittance test results are based upon 1" (25.4 mm) clear high-performance insulating glass [1/4" (e=0.035, #2), 1/2" warm edge spacer and argon fill gas, 1/4"].
2. When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than: .32 (HP glass)

E. “U” Value - Aluminum Entrance Door and Sidelight:

1. When tested in accordance with AAMA 1503, the conductive thermal transmittance (U-Factor) shall not be more than 0.42 BTU/hr/ft2/F. using.24 CoG glass

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than [eight] <Insert number> Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

C. Glazing Accessory Samples: For gaskets, sealants, and colored spacers, in 12-inch (300-mm) length. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For installers, manufacturers of insulating-glass units with sputter-coated, low-e coatings, glass testing agency and sealant testing agency.

G. Product Certificates: For glass and glazing products, from manufacturer.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tinted glass, coated glass, insulating glass, glazing sealants, and glazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

I. Preconstruction adhesion and compatibility test report.

J. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Source Limitations for Glass: Obtain for each type of glass from single source from single manufacturer for each glass type.

E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

H. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

J. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install glazing in mockups specified in Division 08 Section "Aluminum-Framed Entrances and Storefronts", "Aluminum Windows" and Hollow Metal Doors and Frames" to match glazing systems required for Project, including glazing methods.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

K. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. All glass for interior doors, interior sidelights, and interiors windows: Viracon 3/8” tempered glass

B. All glass for exterior Fixed Aluminum-Framed Windows: 1” insulating glass: Vitro Solarban 60#2 with argon filled air space – interior lite to be clear, tempered glass – exterior lite to be tinted to match the tinting in surrounding, existing windows

C. All glass for exterior Aluminum-Framed Entrances (opening 301) including sidelight: 1” insulating glass: Vitro Solarban 60#2 with argon filled air space – interior lite to be clear, tempered glass – exterior lite to be tinted to match the tinting in surrounding, existing windows

D. Thickness: see above

E. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, or silicone gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.3 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. Glazing Sealant for Weather Seal: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 790.
   b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
   c. Pecora Corporation; 890.
   d. Sika Corporation, Construction Products Division; SikaSil-C990.

2. Applications: For weather seals.

C. Glazing Sealant for Structural Seal: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Corning Corporation; 799 for field use and 893 for shop application.
   b. GE Advanced Materials - Silicones; UltraGlaze SSG4000AC for field use. and UltraGlaze SSG4000 for shop application
   c. Polymeric Systems, Inc.; PSI-631.
   d. Schnee-Morehead, Inc., an ITW company; SM5731 Poly-Glaze Plus.

2. Applications: For Structural Seals.

D. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.4 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.5 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.6 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant where recommended by manufacturer.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

C. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets.

3.7 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Project Acceptance by the OMH. Wash glass as recommended in writing by glass manufacturer.

3.8 MARKING DECALS

A. Install two marking decals on each transparent glass door, and on each transparent glass sidelight which is wider than 20 inches between stiles. Locate decals midway between stiles 34 inches and 64 inches above the floorline.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SEISMIC:

Below are the seismic criteria for this project, work of this section should take into account this criteria:

Seismic Requirements (BC1613 – ASCE 7, CH 10)	**Item**	**Value**
General	Seismic Risk Category	IV
	Site Class	B
	Seismic Design Category	A

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

B. Note: where assemblies must conform to UL-Listed requirements, materials used in this section must also confirm to those requirements.

C. Note: the slab to slab in the project area may vary.

1.4 PERFORMANCE CRITERIA

A. Performance Criteria: For gypsum drywall and gypsum board shaft wall assemblies, the following performance criteria apply:

1. Loading Criteria, Typical Partitions: Design and install gypsum board components so that the completed partition will withstand a minimum inward and outward pressure of 5 psf normal to the plane of the wall.

2. Loading Criteria, Special Partitions: Design and install gypsum board components so that the completed system will withstand the minimum inward and outward pressure of not less than 10 psf normal to the plane of the wall. This criteria shall apply to the following areas:

a. Partitions surrounding stairs.
b. Partitions surrounding plenum and air shafts.
c. Partitions surrounding atriums.

3. Deflection Criteria

a. Deflection, Support Framing Gypsum Board Partitions: Deflection of support framing for gypsum board partition systems shall be limited to 1/240 of the span in height, except as otherwise shown or specified.

b. Deflection, Support Framing Gypsum Board Ceilings: Gypsum board interior suspended ceilings shall be designed for deflection not to exceed l/360 of the distance between supports

c. Deflection, Support Framing Shaftwall Systems: Deflection of shaftwall systems shall be limited to 1/240 of the span in height. In areas where room side finish is veneer plaster, lath and plaster or ceramic tile, deflection of shaftwall systems shall be limited to 1/360 of the span in height.

B. Design Modifications: Make design modifications only as may be necessary to meet performance requirements and coordinate the Work. Variations in details and materials which do not adversely affect appearance, durability or strength shall be submitted to the Architect for review.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Certification: From Installer indicating compliance of selected non-structural metal framing components, with performance requirements specified in this Section for each partition type indicated on partition schedule.

1.6 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
2. Protective Coating: ASTM A 653, G60 hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.0625-inch- diameter wire, or double strand of 0.0475-inch- diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Cast-in-place anchor, designed for attachment to concrete forms.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
2. Steel Studs: ASTM C 645.

a. Minimum Base-Metal Thickness: As indicated on Drawings.
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base Metal Thickness: As indicated on Drawings.

4. Resilient Furring Channels: 1/2-inch deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped.

G. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; 640-C, Fire Front 650-C, 660-C or Fire Front 670-C Drywall Furring System.

c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings and as required to comply with performance criteria for limiting heights indicated, except min. 0.0312 in. thick at fire door frames supporting standard and heavy weight doors.

a. "S125" and "S200" series (Unimast Corp.), for interior partitions, ceilings and column fireproofing.
b. Steel "C-H Stud" or "E-Stud" (Unimast Corp.) for cavity shaftwall construction.
c. Steel "C-Stud" or "H-Stud" (Unimast Corp.) for solid shaftwall construction.

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
2) Superior Metal Trim; Superior Flex Track System (SFT).

C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, provide one of the following:

a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
b. Metal-Lite, Inc.; The System.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0598 inch.

E. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.

1. Depth: As indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: As indicated on Drawings.
2. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

H. Cold-Rolled Furring Channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch.
3. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.0625-inch diameter wire, or double strand of 0.0475-inch diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

    a. Single-Layer Application: 16 inches o.c., unless otherwise indicated.
    b. Multilayer Application: 16 inches o.c., unless otherwise indicated.
    c. Tile backing panels: 16 inches o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb, unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.

D. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 – GYPSUM DRYWALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.
2. ~~Exterior gypsum board for ceilings and soffits.~~
3. ~~Tile backing panels.~~
4. ~~Aluminum reveal trim – use aluminum reveal trim at all locations where a reveal is indicated on the drawings.~~

B. This section may include UL Listed assemblies. If so, the UL listed assemblies will be indicated on the drawings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch long length for each trim accessory indicated.
2. Textured Finishes: 12 inch x 12 inch square for each textured finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36 or ASTM C 1396, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. USG Corporation
b. BPB America Inc.
c. G-P Gypsum.
d. Lafarge North America Inc.
e. National Gypsum Company.
f. American Gypsum Co.

B. Regular Type:

1. Type X:
2. Thickness: 5/8 inch.

3. Long Edges: Tapered.

C. Flexible Type: Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

D. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

E. Abuse-Resistant Type: 5/8 inch thick, or as required. Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than regular-type and Type ‘X’ gypsum board.

1. Location: Patient areas (walls and ceilings), and high abuse areas. Provide fire rated Abuse-Resistant gypsum board where required due to fire ratings.

F. High Impact Type: 5/8 inch thick. Manufactured with Type ‘X’ core, plastic film laminated to back side for greater resistance to through-penetration (impact resistance).

1. Manufacturer: Fiberock VHI (USG).
2. Location: Patient areas (walls and ceilings) and areas that require a higher level of through-penetration (impact resistance).

G. Moisture- and Mold-Resistant Type: 5/8” thick, or as required, with moisture- and moldresistant core and surfaces.

1. Location: Showers, tubs, bathrooms, janitor’s closets, kitchens and other wet areas.

2.2 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS (not used)

A. Exterior Gypsum Soffit Board: ASTM C 931or ASTM C 1396, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Gypsum Co.
b. BPB America Inc.
c. G-P Gypsum.
d. Lafarge North America Inc.
e. National Gypsum Company.
f. PABCO Gypsum.
g. Temple.
h. USG Corporation.

2. Core: 5/8 inch, Type X.

3. Fasten with corrosion-resistant screws.

B. Glass-Mat Gypsum Sheathing Board: 5/8” thick, or as required.

1. Fasten with corrosion-resistant screws.

2.3 TILE BACKING PANELS (use at tile backsplash in Pantry)

A. Glass-Mat, Water-Resistant Backing Board:

1. Core: 5/8 inch, Type X.

2. Complying with ASTM C 1178.

a. Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum.

b. Location: Showers, tubs, and other wet areas scheduled to receive tile.

3. Complying with ASTM C1177.

a. Product: Subject to compliance with requirements, provide "DensArmor Plus Interior Guard" by G-P Gypsum.

b. Location: Showers, tubs, and other wet areas scheduled to receive tile.

B. Cementitious Backer Units: ANSI A108.1.

1. Products: Subject to compliance with requirement, provide one of the following:

a. Custom Building Products; Wonderboard.
b. FinPan, Inc.; Util-A-Crete Concrete Backer Board
c. USFG Corporation; DUROCK Cement Board

2. Thickness: Manufacturer's standard thickness.
3. Location: Showers, tubs, and other wet areas scheduled to receive tile.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Provide continuous aluminum trim at all locations on drawings where a reveal is indicated. .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Pittcon Industries - #STR-050-063 unless otherwise indicated.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.

3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified and to be painted to match adjacent construction as directed by Architect.

4. Unless otherwise indicated, provide the following channel wall reveals for use in wall surfaces to create wall reveals, and jamb reveals for use at hollow metal frames to terminate gypsum drywall.

   a. Jamb Reveal

      1) "STR-050-050" (Pittcon Industries)
      2) "DRMZ-50-50" (Fry RegletArchitectural Metals).
      3) "Series 300 312-1/2" (Gordon Inc.).

   b. Channel Wall Reveal

      1) "SWR-050-050" (Pittcon Industries)
      2) "DRM-50-50" (Fry RegletArchitectural Metals).
      3) "Series 500 512-1/2" (Gordon Inc.).

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound. At impact resistant partitions prefill using Durabond Compound (USG) to set tape prior to sanding and finishing.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type, sandable topping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.

4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Acoustical Sealant: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C834, that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. One of the following:

1. "SHEETROCK Acoustical Sealant" (U. S. Gypsum Co.).
2. "AC-20 FTR Acoustical and Insulation Sealant" (Pecora Corp.).

E. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission

F. Sound Attenuation Blankets: ASTM C665, Type I Unfaced mineral-fiber blanket insulation with water-resistant binders produced by combining mineral fibers of glass, slag wool, or rock wool type with thermosetting resins (blankets without membrane facing) thermal conductivity of “k” = 0.25 Btu in./hr. ft.2 o F. at 75 deg. F. Minimum 3 pcf density. ASTM E84, flame spread 15, smoke developed 10, or less. Provide manufacturer’s standard sizes in thickness indicated.. For fire-resistance rated assemblies comply with mineral-fiber requirements of assembly. Provide one of the following:
1. “Sound Attenuation Fire Blankets” (Thermafiber LLC).
2. “FBX Sound Control Blanket” (Fibrex Inc.).
3. “Acoustical Fire Batt” (Roxul Inc.).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Where acoustical insulation is indicated within full height gypsum board assemblies, seal construction at perimeters, behind control and expansion joints, opening and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Include sealing partitions above acoustical ceilings.

3.3 PARTITION ASSEMBLIES

A. For 1 Hour Rated Walls: Comply with requirements of UL rated assemblies in manufacturer's Partition Selector. Apply 1 layer 5/8 inch thick, Type X, Fiberock VHI on both sides of metal studs in lieu of Type X gypsum board.

B. For 2 Hour Rated Walls: Comply with requirements of UL rated assemblies in manufacturer's Partition Selector. Apply base layer of 5/8 inch thick, Type X, Fiberock VHI on both sides of metal studs, and finish layer on both sides of 5/8 inch thick, Type X gypsum board.

C. Non-Rated Shower Walls, Apply base layer 5/8 inch thick, Type X, Fiberock VHI and finish layer of 7/16 in. cement board.

D. For Bathroom Walls: Apply base layer of 5/8 inch thick, Type X Fiberock VHI and finish layer 5/8 in. thick moisture resistant board.

E. For 1 hour and 2 hour rated shaft wall refer to Division 09, Section "Gypsum Wall Shaftwall Assemblies".

3.4 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Regular Type X: For use throughout unless other type is required as indicated on drawings and specified herein. .
2. Impact Type X: Where required for specific impact resistant assembly indicated.
3. Flexible Type: As indicated on Drawings.
4. Ceiling Type: Ceiling surfaces.
5. Abuse-Resistant Type: Vertical surfaces to 8 ft.-0in. high.
6. Moisture- and Mold-Resistant Type: At all custodial rooms, soiled utility and soiled utility holding rooms, single-use toilet rooms to deck, at walls behind and around sinks (wall mounted and countertop types) to deck, and at walls within a 5 ft.-0 in. diameter radius from exterior doors.
7. Cementitious Backerboard: At tiled walls of shower and bath enclosures.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners].

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.5 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Fasten with corrosion-resistant screws.

3.6 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at all patient room toilets and stretcher shower locations. Install with 1/4-inchgap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.1, at showers, tubs and where indicated.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.7 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings to comply with ASTM C840 and in specific locations approved by Architect for visual effect. Coordinate locations on shop drawings.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use where indicated.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.8 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges. Level 2 finish shall be applied to WR gypsum board, where panels are substrate for tile, and other locations where indicated.
3. Level 3: Embed tape and apply separate first and fill coats of joint compound to tape, fasteners, and trim flanges. Joint compound shall be smooth and free from tool marks and ridges. Level 3 finish shall be applied to panels in Mechanical Rooms, Electrical Rooms, and similar spaces.
4. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges. Joint compound shall be smooth and free from tool marks and ridges. Level 4 finish shall be applied to panels in all locations except where another level of finish is specified.

5. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface where indicated.

E. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile or for acoustical tile.
3. Level 3: None.
4. Level 4: Typical exposed finish, at panel surfaces that will be exposed to view, unless otherwise indicated.

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

5. Level 5: High Quality Finish: Apply at lobby wall and ceiling surfaces, at areas to receive gloss and semigloss enamels and surfaces designated by Architect where lighting is critical. Coordinate with paint schedule and types. Confirm all locations with Architect in shop drawings.

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

F. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

G. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

H. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.9 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

(UL Listed Assemblies attached on following pages of this Section)

SECTION 09300 - TILE

1. RELATED DOCUMENTS

    1. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2. DESCRIPTION OF WORK:

    A. This Section includes the following:

        1. Tile (in 2 washrooms and 1 janitor's closet)
        2. All tile transitions: coved base, curved corners, and bullnose top
        3. Marble Saddles – provide at all conditions where tile meets other types of flooring.

3. SUBMITTALS:

    A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

    B. Product data for each type of product specified.

    C. Shop drawings indicating tile patterns and locations and widths of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

        1. Locate precisely each joint and crack in tile substrates by measuring, record measurements on shop drawings, and coordinate them with tile joint locations, in consultation with Architect.

    D. Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated, products involve color and texture variations, in sets showing full range of variations expected.

        1. Each type and composition of tile and for each color and texture required, at least 12 inches square, mounted on plywood or hardboard backing and grouted.
        2. Full-size units of each type of trim and accessory for each color required.
        3. Stone thresholds in 6-inch lengths.

    E. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.

4. QUALITY ASSURANCE:

    A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

    B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.

    C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.

D. Preinstallation Conference: Conduct conference at Project site to review tile patterns and colors, and to comply with requirements of Division 1 Section "Project Meetings".

5. DELIVERY, STORAGE AND HANDLING:

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

6. PROJECT CONDITIONS:

A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.

C. Maintain temperatures at 50 deg F (10 deg C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

7. EXTRA MATERIALS: (not used on this project)

8. PRODUCTS: (all by American Olean)

	Room	Location	Tile	Comments
A	(2) Bathrooms	Floor	2”x2” Unglazed Colorbody Porcelain Mosaics	Allow (3) colors: border, field and accents
B		Wall (Wainscot)	Daltile Restore Bright White 4-1/4 in. x 4-1/4 in. Ceramic Wall Tile	Allow (4) colors: field, and (3) separate alternating colors in (1) 4” high band around room
C	(1) Janitors Closet	Floor	2”x2” Unglazed Colorbody Porcelain Mosaics	Allow (1) color
D		Wall (Wainscot)	Daltile Restore Bright White 4-1/4 in. x 4-1/4 in. Ceramic Wall Tile	Allow (1) color
E	(2) Bathrooms, (1) Janitor’s Closet	All	All transitions to be coved or curved, use all trims: a. cove base, b. bull nose cap, c. curved internal corners in base, wall, and bullnose cap, d. curved external corners in base, wall, and bullnose cap	
F	(1) Drinking Fountain (1) Staff Lounge	Wall	1”X2” St. Germain Colorbody Porcelain, (12”x12” sheets)	Backsplash: - to underside of soffit at drinking fountain - to underside of cabinet at staff lounge

9. PRODUCTS, GENERAL:

A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.

1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.

B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Provide selections made by Architect from manufacturer's full range of standard colors, textures, and patterns for products of type indicated.

10. TILE PRODUCTS:

A. See finish schedule for colors/patterns/location

B. Trim Units: Provide tile trim units at all locations described in item 2. (below) to match characteristics of adjoining flat tile and to comply with following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
2. Shapes: As follows, selected from manufacturer's standard shapes:

a. Base for Portland Cement Mortar Installations: Coved.
b. Wainscot Cap for Thinset Mortar Installations: 4" Surface bullnose.
c. External Corners for Thinset Installations: Surface bullnose.
d. Internal Corners: Round in corners.

11. STONE THRESHOLDS:

A. General: Provide beige granite that is uniform in color and finish, custom fabricated to sizes and profiles indicated on drawings to provide transition between tile surfaces and adjoining finished floor surfaces.

B. Stone Thresholds: Provide sand-colored marble thresholds complying with ASTM C 503 requirements for exterior use and for abrasion resistance where exposed to foot traffic, a minimum hardness of 10 per ASTM C 241.

1. Color: Sand, to be selected by Architect

12. SETTING MATERIALS:

A. Organic Adhesive: ANSI A136.1, Type I.

13. GROUTING MATERIALS:

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated, with latex grout additive as shown below:

1. Latex additive (water emulsion) serving as replacement for gauging water, added at job site with dry grout mixture, with type of latex and dry grout mix as follows:

a. Latex Type: Manufacturer's standard.
b. Conform to ANSI A118.6.
c. Do not add water.

14. MIXING MORTARS AND GROUT:

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

15. EXAMINATION:

A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

16. PREPARATION:

A. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

B. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:

1. Petroleum paraffin wax, applied hot.
2. Grout release.
3. Petroleum paraffin wax or grout release.

17. INSTALLATION, GENERAL:

A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.

B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated.

C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.

E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.

   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Grout tile to comply with the requirements of the following installation standards:

   1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI A108.10.

18. FLOOR INSTALLATION METHODS:

A. Ceramic Mosaic Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types:

   1. Organic Adhesive: ANSI A108.4. (setting bed for use on interior concrete subfloors)

   2. Sanded Grout with Latex Additive: ANSI A108.10 (for use in grouting joints)

19. CLEANING AND PROTECTION:

A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

   1. Remove latex-portland cement grout residue from tile as soon as possible.
   2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.

1. When recommended by tile manufacturer, apply protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 093000

SECTION 095123 – ACOUSTIC TILE CEILINGS

PART 1 - GENERAL

1.1 SEISMIC:

Below are the seismic criteria for this project, work of this section should take into account this criteria:

Seismic Requirements (BC1613 – ASCE 7, CH 10)	Item	Value
General	Seismic Risk Category	IV
	Site Class	B
	Seismic Design Category	A

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. This Section includes acoustical panels, acoustical metal panels and exposed suspension systems for ceilings.

1. All ceilings to meet Seismic Site Class Code B. Use all required accessories to meet this criteria including hold down clips if required.

1.4 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:

1. Ceiling suspension system members.
2. Method of attaching hangers to building structure.

a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Initial Samples: For each exposed finish.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.

E. Product test reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

F. Research/evaluation reports: For each acoustical panel ceiling and components and anchor and fastener type.

G. Maintenance data: For finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Fire-Test-Response Characteristics:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Acoustical panels complying with ASTM for Class A materials, when tested per ASTM E 84.

a. Smoke-Developed Index: 450 or less.

C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Final full size samples may be used in mock-up.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.9 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 10.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 3.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Acoustical Panel Standard: Comply with ASTM E 1264.

B. Metal Suspension System Standard: Comply with ASTM C 635, use Heavy-Duty System

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Expansion anchors fabricated from corrosion-resistant materials, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641, Class 1 zinc coating, soft temper.

1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inchdiameter wire.

E. Seismic perimeter stabilizer bars, seismic struts, and seismic clips. (Seismic Category B)

F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

G. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees, except where indicated to be more closely spaced elsewhere in this section.

2.2 ACOUSTICAL PANELS AND METAL GRID:

The following are the approved products: (no substitutions):

A. Typical (all rooms with ACT shown on A-200 not listed in sections B., C., D., or E. below):

Acoustic Tile: USG SG #808, 2x2, color: white

Edge: Shadowline

Grid: DX/DXL 15/16”, color white

B. Clinical but not Cleanroom: T-210, T-212, T-213, T-215

Acoustic Tile: USG 86343 (2x2) and/or USG 88343 (2x4) – see RCPs for tile sizes, color: white

Edge: SLT

Grid: USG DX/DXL, 15/16”, color: white

C. Cleanroom: (no acoustical tile ceiling in these areas)

D. Main Corridor: T-200

Acoustic Tile: USG 808 (2x2), color: white

Edge: SL

Grid: USG DX/DXL, 15/16”, color: white

E. Rooms outside of project areas that require ceiling replacement:

Acoustic Tile: match existing acoustic tile

Grid: match existing metal grid

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Approved Grid (no substitutions): see above

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Butt-edge.
3. Face Design: Flat, flush.
4. Cap Material: Steel
5. Cap Finish: White baked enamel finish.

2.4 CAP FINISHES

A. Baked-Enamel or Powder-Coat Finish for Interior Storefront and Entrances: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: White

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. Comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.

C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
2. Do not attach hangers to steel deck tabs.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. Hold-Down Clips: Install 2 hold-down clips for each panel (except where indicated more frequently elsewhere in this section. Snap the clips over the center of the cross runner bar webs. Where access is required, use special access type clips.

a. In areas indicated to have fire rated suspended ceilings, provide hold down clips to maintain fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl sheet floor covering with integrally coved base and heat welded seams

2. Provide continuous sealant joint between top of covered base and bottom of clean room wall panelling

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Initial Selection: For each type of floor covering indicated.

D. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern of floor covering required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

E. Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch. Sample applied to a rigid backing and prepared by Installer for this Project.

F. Product Schedule: For floor coverings.

G. Qualification Data: For qualified Installer.

H. Maintenance Data: For each type of floor covering to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for floor coverings including resilient base and accessories.

a. Size: Minimum 100 sq. ft. for each type, color and pattern in locations directed by Architect

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg For more than 85 deg F in spaces to receive floor coverings during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg For more than 95 deg F.

C. Close spaces to traffic during floor covering installation.

D. Close spaces to traffic for 48 hours after floor covering installation.

E. Install floor coverings after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Covering: Furnish quantity not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

PART 2 - PRODUCTS

2.1 VINYL SHEET FLOOR COVERING

A. Products: Armstrong Medintech

B. Unbacked Vinyl Sheet Floor Covering: ASTM F 1913, 0.080 inch thick.

C. Wearing Surface: Smooth.

D. Sheet Width: As standard with manufacturer.

E. Seaming Method: Heat welded.

F. Colors and Patterns: As selected by Architect from full range of industry colors. Assume:
1. There is one color on the project except as noted in F2. (below)
2. In Anteroom, there are (2) colors, divided by the Line of Demarcation,

G. All sheet vinyl flooring to have integrally coved 4” high base

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

a. Color: As selected by Architect from manufacturer's full range to contrast with floor covering.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch radius provided or approved by manufacturer.
2. Cap Strip: Tapered vinyl cap provided or approved by manufacturer.

E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. min 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor coverings until they are same temperature as space where they are to be installed.

1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 FLOOR COVERING INSTALLATION

A. Comply with manufacturer's written instructions for installing floor coverings.

B. Unroll floor coverings and allow them to stabilize before cutting and fitting.

C. Lay out floor coverings as follows:

1. Maintain uniformity of floor covering direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

I. Integral-Flash-Cove Base: Cove floor coverings dimension indicated up vertical surfaces. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

B. Perform the following operations immediately after completing floor covering installation:

1. Remove adhesive and other blemishes from floor covering surfaces.
2. Sweep and vacuum floor coverings thoroughly.
3. Damp-mop floor coverings to remove marks and soil.

C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.

1. Apply two coat(s).

E. Cover floor coverings until Occupancy.

END OF SECTION 096516

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile (VCT).

2. Wall base at VCT

B. Related Sections:

1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.
2. Division 09 Section "Resilient Sheet Flooring" for resilient sheet floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Initial Selection: For each type of floor tile indicated.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

E. Product Schedule: For floor tile.

F. Qualification Data: For qualified Installer.

G. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for floor tile including resilient base and accessories.

a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg For more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE <VCT>

A. Base Bid VCT:

- Armstrong Premium Excelon Crown Texture– Allow for (2) colors on project

- There will be one color per room except Main Corridor in Cellar Pharmacy to have 6” border

B. Rubber Base at VCT:

a.) Vinyl Base: 6” vinyl base, Architect will choose from either Mannington or Johsonite

C. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

D. Wearing Surface: Smooth.

E. Thickness: 0.125 inch.

F. Size: Varies – see plan.

G. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft.in 24 hours.
b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coat(s).

E. Cover floor tile until Occupancy.

END OF SECTION 096519

SECTION 097200 - CLEAN ROOM WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes labor, materials and other services necessary to complete installation of cleanroom wall panels, from top of vinyl base to underside of acoustic tile ceiling, including: adhering panels to the walls, sealant on all 4 sides of panel, height of sheets to be sufficient to avoid any horizontal joints, in the following rooms:
- A300: All walls in rooms T-211, T-211A, T-211B, and T-211C

B. Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the work of this Section.

1.2 REFERENCES

A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. American Society for Testing & Materials (ASTM):
1. AST ASTM E 84-05 Standard Test Method for Surface Burning Characteristics of Building Materials. CLASS A
2. ASTM D5420 Gardner Impact Exceeds 80 inch pounds

1.3 SYSTEM DESCRIPTION

A. Performance Requirements: Provide products listed in section 2.0 that are suitable for an ISO 7 cleanroom environments and to maintain performance criteria stated by manufacturer without defects.

1.4 (not used)

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s current printed product literature, specifications, installation instructions, and field reports in accordance with Section 01330 - Submittal Procedures.

B. Shop Drawings: Submit shop drawings to indicate materials, details, and accessories in accordance with Section 01330 - Submittal Procedures including but limited to the following:

1. Submit a layout diagram indicating the location of each panel and joining method.

C. Samples: Submit duplicate sample pieces of material, as well as accessory pieces in accordance with Section 01330 - Submittal Procedures.

D. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance charac-

teristics and physical properties.

2. Manufacturer's Instructions: Current published manufacturer's installation and maintenance instructions.

3. Manufacturer's Field Reports: Specified herein.

E. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

2. Warranty: Warranty documents specified herein.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project.

1. Training: Installer who has a min. of five years of experience installing wall covering.

C. Mock-ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.

1. Mock-Up Size: 8' wide by full height

1 Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.

2. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

D. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

1.7 DELIVERY, STORAGE & HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

B. Deliver, store and handle wall panels in accordance with manufacturer requirements.

C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.

E. Store panels in temperature controlled environments. Leave protective blue film on panel until ready to use.

1.8 WASTE MANAGEMENT AND DISPOSAL

A. Deposit all packaging materials in appropriate container on site for recycling or reuse.

B. Avoid using landfill waste disposal procedures when recycling facilities are available.

C. Keep all discarded packaging away from children.

1.9 PROJECT CONDITIONS

A. Temperature Requirements: If storage temperature is below 65F (18C), the Altro Puraguard wall panel must be moved to a warmer place and allowed to reach this temperature before installation. For further information, refer to current Installation Guide.

B. Maintain air temperature and structural base temperature at installation area between 65F (18C) and 80F (26C) for 48 hours before, during and 24 hours after installation.

1.10 WARRANTY

A. Project Warranty: 10 years on all materials and entire installation.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1.11 EXTRA MATERIALS

A. Provide extra materials of product and adhesives in accordance with Section 01780 - Close-out Submittals.

B. Provide 10% of each color, pattern and type material required for project for maintenance use.

C. Clearly identify each wall panel and each container of adhesive.

D. Deliver to Owner, upon completion of the work of this section and store where directed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Crane Composites "Glasbord Smooth FRP with Surfaseal", suitable for ISO 7 cleanrooms, in Class A Fire Rating per ASTM E-84" (https://cranecomposites.com/bp/cleanrooms.html)

B. Panel Size: Use panel height which extends from top of coved base to underside of acoustic tile ceiling with no horizontal joints.

C. Adhesive: Use best quality, adhesive, compatible with walls and panels, as recommended by manufacturer.

D. Sealant: Use white, pick-proof sealant on all sides of each panel, compatible with walls and panels, as recommended by manufacturer. Owner preference is: 3M 5200 Polyurethane Adhesive/Sealant, color: white. Confirm compatibility with panels.

2.2 SOURCE QUALITY

A. Source Quality: Obtain wall products from a single manufacturer.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog, installation instructions and product label instructions for installation.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 SUBSTRATE PREPARATION

A. Walls should be smooth and level. High points must be removed and low points filled with filler intended for the substrate and environmental conditions.

B. Surfaces must be permanently dry and free from all substances that may contribute to adhesive bond failure.

C. Remove loose paint and conduct an adhesive bond test with paint.

D. Exterior walls must be adequately damp-proofed and insulated.

E. Dry wall substrates should be paint ready.

3.4 PREPARATION

A. All surfaces must be free from dust and cleaned prior to installation. The working environment must also be dust free. Failure to comply with these conditions will reduce the bond strength between the adhesive and substrate, and may cause the panels to de-bond.

B. All electrical switches, power points etc., should be in a first fix / installation state. All electrical equipment should only be moved or altered by a qualified electrician.

C. All plumbing should have pipe-work removed to a first fix or installation state and "tails" left protruding from the substrate. Panels can then be drilled and slid over the pipe tails. All holes should be drilled 1/8" (3mm) oversize to allow for expansion, then sealed with Altro Sanitary Sealant. Plumbing should always be done by a qualified plumber.

D. Hot pipes and steam pipes should be insulated and a 1/8" to 1/4" (3-6mm) expansion gap should be created when installing panels around these pipes, then sealed with Sanitary Sealant.

E. All pipes, fixing bolts, etc. extending through the panels should have a minimum 1/8" (3mm) expansion gap and be sealed using Sanitary Sealant.

F. If fitting to door frames, these must be in place prior to installation of the panels..

G. Prior to installation, it is advisable to complete any painting which comes in contact with the panels as sealant used at junctions is non-paintable.

H. Panels should be stored flat and be pre-conditioned a minimum of 24 hours in ambient temperatures similar to the prevailing operational conditions.

I. The panels must be stored on a level flat surface off the ground (risk of condensation on the panels if stored on damp surfaces). Storage on uneven surfaces could cause the panels to distort prior to installation.

J. First, check the room using a 6’ (2 m) level to ensure all walls are flat, paying particular attention to the corners, window reveals, and door entrances. These need to be inspected to ensure they are free of any debris or irregularities, which could prevent the panels from laying flat to the substrate after the adhesive has been applied and the panel installed.

3.5 INSTALLATION

A. Install panels in accordance with the current manufacturer Installation Guide.

3.6 FIELD QUALITY REQUIREMENTS

A. Manufacturer’s Field Services: Upon Owner’s request, provide manufacturer’s field service consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer’s instructions.
1. Site Visits: 9 (three per phase)

3.7 CLEANING

A. Per manufacturer guidelines.

3.8 PROTECTION

A. Do not install near open heat sources (ovens, etc). Stainless steel panels should be used in such areas.

END OF SECTION 097200

09900 - PAINTING

1. RELATED DOCUMENTS:

    1. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2. DESCRIPTION OF WORK

    A. This Section includes surface preparation, painting, and finishing of all exposed paintable and/or previously painted or previously wallpapered items and surfaces. Do not paint existing or new wood casework which has a clear or stained wood finish.

        1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

        2. Allow for (6) separate finish colors on Project.

        3. Painting includes field painting all existing lighting fixtures, exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment, in rooms called out to be painted.

        4. Skim coat and finish smooth all existing walls within project area that are not scheduled to receive new GWB finish.

        5. Non-cleanroom spaces are: all rooms not listed above

        6. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels, and on existing, non-painted wall tile in Founders Hall.

            A. Prefinished items not to be painted include the following factory-finished components:

            1. Acoustic materials.
            2. Architectural woodwork and casework.
            3. Finished mechanical and electrical equipment.

3. JOB CONDITIONS:

    A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).

    B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).

4. MANUFACTURERS:

    A. Manufacturer: Architect will choose products from the following:

        1. Benjamin Moore and Co.

5. Paint Schedule:

5a. SYSTEM #1: (Non-Cleanroom spaces - Ceilings)

Apply on new and existing gypsum drywall ceiling surfaces in non-cleanroom spaces.

A. Low odor, low VOC, 100% Acrylic Latex Flat Finish: 2 coats

B. First Coat:

Moore: Pristine Eco Spec Interior Latex Primer 231

C. Second Coat:

Moore: Pristine Eco Spec Interior Latex Flat 219

5b. SYSTEM #2: (Non-Cleanroom spaces - Walls)

Apply on new and existing gypsum drywall wall surfaces in non-cleanroom spaces.

A. Low odor, Low VOC, 100% Acrylic Latex Eggshell Enamel Finish: 3 coats

B. First Coat:

Moore: Pristine EcoSpec Interior Latex Primer 231.

C. Second and Third Coat: Moore: Pristine EcoSpec Interior Latex Eggshell Enamel 223.

D. Apply additional finish coat where deep color is selected for finish coat. Refer to "Materials" Article in Part 2 of this section.

5c. SYSTEM #3 (Non-Cleanroom spaces – Metal Surfaces)

Apply at ferrous metal surfaces, including steel doors and frames, wiremold and other metal trim indicated to be painted.

A. Low odor, Low VOC, 100% Acrylic Latex Semi-Gloss Enamel Finish: 3 coats with total dry film thickness not less than 2.5 mils.

B. First Coat:

Moore: IronClad Latex Low Lustre Metal and Wood Enamel 363.

C. Second and Third Coat:

Moore: Pristine EcoSpec Interior Latex Semi-Gloss Enamel 224.

D. Omit prime coat (except for touch-up) on items delivered shop-primed, and at previously painted surfaces, where existing coatings are in good condition after surface preparation.

E. Apply additional finish coat where deep color is selected for finish coat. Refer to "Materials" Article in Part 2 of this section.

5d. System #4 (Cleanroom spaces - ceilings)

Apply at all ceilings in cleanrooms:

A. Epoxy paint: 3 coats with total dry film thickness not less than 2.5 mils.

B. First Coat:

Moore:V155 Epoxy Primer

C. Second and Third Coat:

Moore:V341 (eggshell finish)

D. Apply additional finish coat where deep color is selected for finish coat. Refer to "Materials" Article in Part 2 of this section.

5e. System #5 (Cleanroom spaces – Metal Surfaces)

Apply at all doors, and door frames in Anterooms and Compounding Rooms, as well as walls in Vestibules which have ISO Design:

A. Epoxy paint: 3 coats with total dry film thickness not less than 2.5 mils.

B. First Coat:

Moore:V155 Epoxy Primer

C. Second and Third Coat:

Moore:V342 (semi-gloss finish)

D. Apply additional finish coat where deep color is selected for finish coat. Refer to "Materials" Article in Part 2 of this section.

6. EXAMINATION:

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.
1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

7. PREPARATION:

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.
2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
3. Ferrous Metals: Clean nongalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

8. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

9. APPLICATION:

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

1. Paint colors, surface treatments, and finishes will be indicated in a Schedule issued by Architect during the construction phase of the project.
2. Provide finish coats that are compatible with primers used.
3. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
4. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in

place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

6. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind
permanently fixed equipment or furniture with prime coat only before final installation of equipment.
7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
9. Finish interior of wall and base cabinets and similar field- finished casework to match exterior.
10. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
11. Sand lightly between each succeeding enamel or varnish coat.
12. Omit primer on metal surfaces that have been shop-primed and touch up painted.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

D. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.

10. CLEANING:

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

11. PROTECTION:

A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 09900

SECTION 100000 - Miscellaneous Specialties

1. Description of Work:

   A. Extent of FF&E provided and installed by contractor is shown in list below. This section includes supply and install of:

      1. Cleanroom pass-throughs
      2. Mail Station Unit
      3. Clock

2. Submittals:

   A. Product Data: Submit manufacturer's data and installation instructions for each type of unit.

      1. Include independent laboratory certification that unit meets project requirements.

   B Shop Drawings: Submit shop drawings for laboratory furniture showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fixtures with lines thereto. Show details and location of anchorages and fitting to floors, walls, and base. Include layout of units with relation to surrounding walls, doors, windows, and other building components.

   C Coordinate shop drawings with other work involved.

3. Products:

   The following are approved manufacturers and product #s. Include complete supply and installation. No substitutions are allowed unless there is some problem with these products in opinion of contractor, if so, contractor to contact Architect immediately to discuss/resolve:

Item	Mfr.	#	Spec	Comments
Cleanroom Pass-Throughs	Terra-Universal	2	CleanMount® CleanSeam™, 18" W x 18" D x 24" H ID, Center Wall Mount, 316L	www.terrauniversal.com Order to arrive (4) months before product is needed. Carefully examine product at the time of delivery for any imperfections. Send back to mfr. to correct any deficiencies and obtain return of product prior to date of scheduled installation.
		1	CleanMount® CleanSeam™, 18" W x 18" D x 24" H ID, Flush Mount, 316L	
Mail Station Unit	School Outfitters	1	Mail Master Sorting Station w/ Riser & Storage (SKU: DAT-3LGL)	www.schooloutfitters.com
Clock	TBD			

4. Submittals: Provide submittals for review. Provide submittals early in process to allow for long lead time

nature of these specialty products, especially regarding the pass-throughs (see notes above)

5. Installation per Manufacturer Instructions

6. Warranty: Lifetime Warranty

END OF SECTION 100000

SECTION 102000 - LOUVERS

1. RELATED DOCUMENTS:

   1. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2. DESCRIPTION OF WORK:

   A. This Section includes the following:

      1. Louvers installed in exterior walls

2. RELATED SECTIONS: The following sections contain requirements that relate to this section.

   1. Section 07900 - Joint Sealers for sealants installed in perimeter joints between louver frames and adjoining construction.
   2. Division 15 - Mechanical for ductwork connected to metal wall louvers.

3. DEFINITIONS:

   A. Louver Terminology: Refer to AMCA Publication 501-85 for definitions of terms for metal louvers not otherwise defined in this section or referenced standards.

5. SYSTEM PERFORMANCE REQUIREMENTS:

   A. Structural Performance: Design, engineer, fabricate, and install exterior metal wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors:

      1. Wind Load: Uniform pressure (velocity pressure) of 55 lbf per sq. ft. acting inwards or outwards.

      2. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss.

         a. Temperature Change (Range): 100 deg F (55.5 deg C).

   B. Air Performance, Water Penetration, and Air Leakage Ratings: Provide louvers complying with performance requirements indicated as demonstrated by testing manufacturers stock units, of height and width indicated, according to Air Movement and Control Association (AMCA) Standard 500.

6. SUBMITTALS:

   A. Product data for each product indicated.

   B. Shop drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and

construction; free areas for each size indicated; and profiles of frames at jambs, heads and sills.

1. Where installed products are indicated to comply with certain structural design loadings, include structural computations, material properties, and other information needed for structural analysis which has been prepared by, or under the supervision of, a qualified professional engineer.

C. Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors available for those units with factory-applied color finishes.

D. Product test reports evidencing compliance of units with performance requirements indicated.

E. Product certificates signed by louver manufacturers certifying that their products which comply with Project requirements are licensed to bear AMCA Seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.

F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience.

7. QUALITY ASSURANCE:

A. Single Source Responsibility: Obtain louvers and vents from a single source where alike in one or more respects with regard to type, design, and factory-applied color finish.

B. Qualify welding processes and welding operators in accordance with D1.2 "Structural Welding Code - Aluminum" and D1.3 "Structural Welding Code - Sheet Steel."

1. Certify that each welder employed in unit of Work of this section has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
2. Testing for recertification is Contractor's responsibility.

C. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated which has resulted in the successful installation of louvers similar in material, design, and extent to that indicated for this Project.

D. SMACNA Standard: Comply with SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

8. PROJECT CONDITIONS:

A. Field Measurements: Check actual louver openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabrication of louvers and vents without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

9. MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide the following:

1. Louvers:

a. ELF375DX by Ruskin Mfg. (https://www.ruskin.com/model/elf375dx)
b. MEP Engineer to verify louver type, sizes, and free area ratio

10. MATERIALS:

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Fasteners: Of same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals which are corrosive or incompatible with materials joined.

1. Use types, gages, and lengths to suit unit installation conditions.
2. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

C. Anchors and Inserts: Of type, size, and material required for type of loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

11. FABRICATION, GENERAL:

A. General: Fabricate louvers and vents to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

B. Preassemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of size indicated with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated but not further apart than recommended by manufacturer, or 72 inches o.c., whichever is less. At horizontal joints between louver units provide horizontal mullions except where continuous vertical assemblies are indicated.

G. Provide sill extensions and loose sills made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.

H. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated, or size of louver assembly makes bolted connections between frame members

necessary:

1. With fillet welds, concealed from view.
2. With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with louver manufacturer.

12. FIXED EXTRUDED ALUMINUM WALL LOUVERS:

A. Horizontal Drainable Fixed Blade Louvers: Extruded aluminum frames and louver blades; designed to collect and drain water to exterior at sill by means of gutters in front edges of blades and of channels in jambs and mullions; complying with the following requirements.

1. Louver Depth: 4 inches, unless otherwise indicated.
2. Frame Thickness: 0.081 inch, unless otherwise indicated.
3. Louver Blade Thickness: 0.081 inch, unless otherwise indicated.
4. Louver Blade Angle: 42-1/2 degrees, unless otherwise indicated.
5. Performance Requirements: As follows, determined by testing units 48 inches wide by 48 inches high per AMCA Standard 500:

a. Louver Free Area: Not less than 50% of overall louver size.
b. Static Pressure Loss: Not more than 0.15 inch water gage at an airflow of 1000 fpm free area intake velocity.
c. Water Penetration: Not more than 0.02 oz. per sq. ft. of free area at an airflow of 1450 fpm free area velocity when tested for 15 minutes.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

13. LOUVER SCREENS:

A. General: Provide louvers with screens.

B. General: Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Interior face, unless otherwise indicated.
2. Screening Type: Insect screening.

C. Secure screens to louver frames with screws, spaced at each corner and at 12 inch o.c. between.

D. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

1. Metal: Same kind and form of metal as indicated for louver frames to which screens are attached.

a. Reinforce extruded aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewireable frames with a driven spline or insert for securing screen mesh.

E. Louver Screening for Aluminum Louvers: Fit aluminum louver screen frames with screening

covering louver openings and complying with the following requirements:

1. Insect Screening: 18 x 16 mesh formed with 0.012 inch diameter aluminum wire.

14. FINISHES, GENERAL:

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish louvers after assembly.

15. ALUMINUM FINISHES:

A. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

B. Class I Clear Anodized Finish: AA-M12C22A42/A41 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, Medium Matte; Anodic Coating: Class I Architectural, clear film thicker than 0.7 mil) complying with AAMA 606.1 or AAMA 608.1.

16. PREPARATION:

A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of anchorages which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

17. INSTALLATION:

A. Locate and place louver units plumb, level, and in proper alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations and refinish entire unit, or provide new units.

F. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses where required to make louver joints weathertight. Comply with Division 7

Section "Joint Sealers" for sealants applied during installation of louver.

18. Adjusting and Protection:

A. Protect louvers and vents from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.

B. Restore louvers and vents damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by Architect, remove damaged units and replace with new units.

1. Clean and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

C. Test operation of adjustable wall louvers and adjust as needed to produce fully functioning units which comply with requirements.

19. CLEANING:

I. Periodically clean exposed surfaces of louvers and vents, which are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.

J. Before final inspection, clean exposed surfaces with water and with a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

END OF SECTION 102000

SECTION 102600 – WALL PROTECTION AND WALL COVERING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Vinyl Wall guards.
2. Recessed, Full Height Vinyl Corner Guards
3. Impact-Resistant Vinyl Wall Panels

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for metal angle corner guards and pipe guards.
2. Division 08 Section "Door Hardware" for metal armor, kick, mop, and push plates.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform load of 50 lbf/ft. applied in any direction.
2. Concentrated load of 200 lbf applied in any direction.
3. Uniform and concentrated loads need not be assumed to act concurrently.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected.

1. Wall and Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.
2. Impact-Resistant Wall Covering: 6 by 6 inches square.

D. Qualification Data: For qualified Installer.

E. Material Certificates: For each impact-resistant plastic material, from manufacturer.

F. Material Test Reports: For each impact-resistant plastic material.

G. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

H. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Division 01 Section "Quality Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Fire-Test-Response Characteristics: Provide impact-resistant, plastic wall-protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

E. Fire Hazard Classification: Provide Class A Interior Finish rating when tested in accordance with ASTM E84 (Surface Burning Characteristics of Building Materials), yielding equal to or less than the following results:

1. Flame Spread: 25.
2. Smoke Developed: 450.

F. Regulatory Requirements: Comply with applicable provisions in [the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

G. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg Fduring the period plastic materials are stored.

2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

    a. Store corner-guard covers in a vertical position.
    b. Store wall-guard, and handrail covers in a horizontal position.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg Ffor not less than 72 hours before beginning installation and for the remainder of the construction period.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures.
    b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Guard and Handrail Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 8-foot long units.
2. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 4-foot long units.

B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All Vinyl Wall Protection Products: Construction Specialties (www.c-sgroup.com)

2.2 MATERIALS

A. Extruded Rigid Plastic: High-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout.

B. Plastic Sheet Wall Covering Material: Semirigid, high-impact-resistant PVC or acrylic-modified vinyl plastic sheet with integral color throughout.

C. Aluminum Extrusions: ASTM B 221.

D. Stainless-Steel Sheet: ASTM A 240.

E. Medium-Density Fiberboard: ANSI A208.2, Grade MD.

F. Particleboard: ANSI A208.1, Grade M-2.

G. Fasteners: Aluminum, nonmagnetic stainless steel, or other noncorrosive metal; security-type where exposed to view.

H. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

2.3 PRODUCTS (all by Construction Specialties)

Product	Mfr.	Product #	Location
Lower Crash Rail (along bottom of Acrovyn Wall Covering)	C-S	5” diameter, SCR-50MN, Acrovyn 4000	All walls in room T-200
Upper Crash Rail (along top of Acrovyn Wall Covering)	C-S	2.25” FR-225N, Acrovyn 4000	All walls in room T-200
Acrovyn Wall Covering	C-S	.075” Acrovyn Wall Covering with All Acrovyn Trims	All walls in room T-200
Corner Guard	C-S	CO-8 Series Satin Finish Stain-less Steel Corner Guard with Adhesive	As Noted on Plan

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances[, fire rating,] and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.

2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

a. Provide anchoring devices to withstand imposed loads.
b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
c. Adjust end and top caps as required to ensure tight seams.

B. Install corner guard in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated. Secure corner guards to substrate with fasteners spaced 16" on center maximum.

1. Corner guard retainer assemblies shall be delivered to the job before installation of the wall begins. Where vinyl cove base is to be used, a structural aluminum support base installed at bottom of retainer shall be supplied to provide rigid backup to cove base. Retainer assemblies shall be installed prior to application of drywall, according to the manufacturer's recommendations. Vinyl/acrylic corner guards shall be installed after painting or wall covering has been completed. Installation to conform to manufacturer's approved details.

C. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

D. Crash Rail and Chair Rail: Mount through continuous horizontal blocking either fire retardant treated wood or steel studs 16 ga. minimum. In

1. Install brackets in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install a bracket within 6”-12” of the end of each handrail run. Install units plumb and level, firmly anchored in locations and at heights indicated.

2. Measure and cut aluminum retainer rail, making appropriate allowances for returns and inside/outside corners. Cut aluminum retainer rail square to assure neat vinyl cover butt joints at returns and corners. Deburr aluminum ends of retainer rails before assembly.

3. Install extruded vinyl handrail covers after aluminum retainers, inside corners and returns have been assembled in place and checked for fit and for square joints.

4. Install handrails after painting and/or wall covering has been completed. Installation to conform to manufacturer's approved details.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 104413 – FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers, FEC.

b. Quantity on this project: 2

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches square.

D. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

E. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:

a. Schedules and coordination requirements.

1.4 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.5 SEQUENCING

A. Apply decals and vinyl lettering on field-painted, fire protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304.

B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.2 FIRE PROTECTION CABINET (Architect to choose model from Larsen that conforms to following):

A. Cabinet Type:

1. Construction: Nonrated or Fire rated as required.
2. Cabinet Material: Enameled steel.
3. Mounting: Recessed.
4. Door Material: Steel.
5. Door Glazing: Tempered float glass.
6. Door Style: Center glass with frame.
7. Accessories: Identification lettering with the words "FIRE EXTINGUISHER" applied to the door and wall signage, as required (refer to interior signage standards).
8. Finishes: Baked enamel.

B. Cabinet Construction: 1-hour fire rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch thick, cold-rolled steel sheet lined with minimum 5/8-inch thick, fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Steel sheet.

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. 5/16 in. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Cabinet Trim Material: Same material and finish as door

F. Door Material: Steel.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet door.
2) Application Process: Silk-screened.
3) Lettering Color: Red.
4) Orientation: Horizontal.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
a. Interior of cabinet.
b. Door and frame

2.3 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed, and semirecessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at acceptable to authorities having jurisdiction.

1. Fire Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply decals and vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 105000 - LOCKERS

1. Summary:

   A. Ideal Products, Inc., “Ideal 1000 Series Solid Phenolic Core Lockers”, Configuration “M”, Executive Style Two Tier, 16” (w) x 18” (d) x 72” (h) - https://www.idealockers.com/tech-info/locker-room-design/ideal-1000-locker-illustrator/ - finish: one of the wood or stone finish options on the above webpage, lockable. No substitutions.

   B. Include wood sleepers to raise bottom of lockers 6” above floor (to allow for applied rubber base).

   C. Include sloped metal top to match finish of lockers.

   D. All lockers are in Staff Lounge.

2. Submittals:

   A. Submit the following in accordance with Conditions of Contract and Division Specification sections.

   B. Product data and installation instructions for metal locker units.

   C. Color Samples on squares of same metal to be used for fabrication of lockers.

   D. Shop Drawings that show metal lockers in dimensioned relation to adjacent surfaces. Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information.

   E. Combination Listing for combination locks and their respective locker numbers. Coordinate with shop drawings submittal, if required.

3. Quality Assurance:

   A. Uniformity: Provide metal lockers that are standard products of single manufacturer, with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.

4. Job Conditions:

   A. Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage, and installation.

5. Installation:

   A. Install lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.

6.. Adjust and Clean:

   A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

   B. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105000

SECTION 10800 - WASHROOM ACCESSORIES

1. RELATED DOCUMENTS:

    1. Drawings and general provision of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

2. DESCRIPTION OF WORK:

    A. This Section includes the toilet accessory items shown in Products section below.

3. SUBMITTALS:

    A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

    B. Product Data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gages, profiles, method of mounting, specified options, and finishes.

    C. Schedule: Indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

    D. Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.

4. QUALITY ASSURANCE:

    1. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.

    2. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

5. PROJECT CONDITIONS:

    1. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference and to assure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

6. WARRANTY:

    A. Special Project Warranty: Provide manufacturer's written 5-year warranty against silver spoilage of mirrors, agreeing to replace any mirrors that develop visible defects within warranty period.

7. PRODUCTS:

A. See Washroom Accessory Schedule below: (all are in the bathrooms except (1) mirror and (1) mop rack

Product	Quantity	Keynote	Specification (all by Bobrick)
Mirror (Cleanroom)	1	10.20	B-165-1824
Mirror with Shelf (Washrooms)	2	10.20	B-166-1824
Mop Rack	1	10.23	B-239
36” Grab Bar	2	10.24	B-5606-36
42” Grab Bar	2	10.25	B-5606-42
Recessed Toilet Paper Holder	2	10.26	B-4388
Recessed Paper Towel Disp./Disp.	2	10.27	B-3940
Recessed Soap Dispenser	2	10.28	B-4063

8. FABRICATION:

A. General: Only a maximum 1-1/2-inch diameter, unobtrusive stamped logo of manufacturer, as approved by Architect, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by means of either a printed, waterproof label or a stamped nameplate, indicating manufacturer's name and product model number.

B. General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification of each accessory item by either a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.

C. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

D. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.

E. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent accumulation of moisture, as follows:

1. Provide galvanized steel backing sheet, not less than 22 gage (.034 inch) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

F. Mirror Unit Hangers: Provide system of mounting mirror units that will permit rigid, tamperproof, and theftproof installation, as follows:

1. One-piece galvanized steel wall hanger device with spring action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring special tool to remove.

9. INSTALLATION:

E. Install toilet accessory units in accordance with manufacturers' instructions, using fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

F. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, in accordance with manufacturer's instructions for type of substrate involved.

10. ADJUSTING AND CLEANING:

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION 108000

21940-MH Main Pharmacy 2nd Flr					
Bernstein & Associates, Architects					

Revison: 10/22/2021

TYPE	MANUFACTURER	MODEL NUMBER	Load	Dimming	Comments
F1D 20W	KURTZON	KL-R-3- 2x2- 2/LEDR- 835 UNV WHT - P20W	20.0	0-10v	
F1D 36W	KURTZON	KL-R-3- 2x2- 2/LEDR- 835 UNV WHT - P36W	36.0	0-10v	
F2D 60W	KURTZON	KL-R-3-2X4- 2/LEDR- 835 UNV WHT - P60W	60.0	0-10v	
F14 CR	KENNALL	CMEXR 5F R DT NT EL	5.0	NA	

KURTZON
SPECIFICATION GRADE LIGHTING
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PROJECT 21940-MH Main Pharmacy 2nd Flr
DATE
TYPE F1D-20W
NOTES KL R 3 2X2 2/LEDR 835 UNV WHT P20W

REV: 10/08/2019

Cleanroom **KL Troffers**

1x4, 2x2 and 2x4 High Efficiency LED Luminaires

- **Rated IP66**
- **Suitable for ISO 3-9 Cleanspaces**
- **Suitable for 209E class 1-100,000 Cleanspaces**
- **ETL listed for Wet Locations**
- **One piece overlapping doorframe**
- **Robotically seam welded housing**
- **0-10V 1% dimming comes standard (except 2x2 with HF LED Selection)**
- **Up to 35,000 Lm Delivered @127 Lm/W**
- **DLC Standard and Premium Listings Available**
- **Recessed Housing suitable for Tbar Grid AND Hardlid Installations**
- **Made in the USA by a Family Owned US Corporation**

To See All DLC Listings, Visit www.Kurtzon.com/DLC

ORDERING GUIDE

Series	Installation Type	Material	Size	Source	CCT	Voltage	Options
KL							

Series	Installation Type	Material	Size	Source	CCT	Voltage	Options
KL	**R**: Recessed (Suitable for Flange & Grid)	**3**: White 430 SS Hsg. & Polished 304 SS Door	**1x4**: 1' x 4' Housing	**1/LEDR**	**83 CRI:**	**120V**	**FC:** Fuse & Holder (One Supplied Per Circuit)
		4: White AL Hsg. & Polished 304 SS Door		**2/LEDR**	**830** = 3000K CCT	**277V**	**2/ED**: Two Drivers (Two Circuits)
		5: White AL Hsg. & White AL Door		**2/LEDH**	**835** = 3500K CCT	**UNV**	**EDL:** -40F Electronic Driver
		7: White AL Hsg. & White CRS Door -		**2/LEDHF**	**840** = 4000K CCT	**347V***	**EM10:** 10W Integral LED EM (Specify Input Voltage)
			2x2: 2' x 2' Housing OR **2x4:** 2' x 4' Housing	**2/LEDR**	**850** = 5000K CCT		**EM20:** 20W Remote LED EM (Specify Input Voltage)
				2/LEDH			**WHT:** White Finished Door & HSG
				3/LEDR	**90+ CRI:**		**LEX:** .125" Prismatic Polycarbonate
				3/LEDH	**935** = 3500K CCT		**A19**: .156" Prismatic P19 Pattern Clear Acrylic
				4/LEDR	**940** = 4000K CCT		**HIA:** .140" High Impact P12 Pattern Clear Acrylic
				4/LEDH	**950** = 5000K CCT		**TG:** .156" Prismatic Tempered Glass
				4/LEDHF			**SW:** Wet Locatoin Hub Supplied (not installed)
	S: Surface	**1:** White CRS Hsg. & White CRS Door	**1x4**: 1' x 4' Housing	**1/LEDR**			**PxL:** Programmed to User Specified Lumen Value.
		2: White CRS Hsg. & Polished 304 SS Door		**2/LEDR**			**PxW:** Programmed to User Specified Wattage Value.
		3: Polished 304 SS Hsg. & Polished 304 SS Door		**2/LEDH**			**10KV:** 10KV Parallel Surge Protection (One Supplied Per Circuit)
		4: White AL Hsg. & Polished 304 SS Door		**2/LEDHF**			**GTD:** Generator Transfer Device
		5: White AL Hsg. & White AL Door	**2x2**: 2' x 2' Housing OR **2x4:** 2' x 4' Housing	**2/LEDR**			**WHIP:** Must Specify Length and Wire Qty
		6: White CRS Hsg. & White AL Door		**2/LEDH**			**.125 FROST**: 1/8" Frost Acrylic Lens
		7: White AL Hsg. & White CRS Door		**3/LEDR**			**HF1:** 1% Dimming for 2x2 with LEDHF
				3/LEDH			**OCCMW:** Internal microwave OCC Sensor
				4/LEDR			
				4/LEDH			
				4/LEDHF			

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REV: 10/08/2019

Cleanroom **KL Troffers**

1x4, 2x2 and 2x4 High Efficiency LED Luminaires

SPECIFICATIONS

HOUSING: One piece, hole free, robotically seam welded housing has flattened knockouts for a superior seal. Recessed housings are available in .040" 3003 Aluminum or 20Ga 430 Stainless Steel. Surface housings are available in .050" 3003 Aluminum, 18Ga 304 Stainless Steel, or 20Ga Cold Rolled Steel.

DOOR FRAME: One piece door frame with welded corners overlaps the fixture allowing the NSF approved microcellular gasket to seal to the mounting surface. Door frame is hinged by aircraft cables and is supplied with captive stainless steel flush head screws to allow easy wiping of the surface. Available in .050" 3003 Powder coated Alum., 20Ga 304 Polished SS, or 18Ga Powder coated CRS.

GASKETS: NSF Listed closed cell microcellular extruded KleanLock SealPro gasket with vulcanized corners making a one-piece oil and solvent resistant gasket system.

LENS: Impact resistant .135" thick virgin acrylic with P12 prismatic pattern inverted. Sealed to door with NSF listed RTV silicone. See "Options" for other choices.

LEDS: Commercially available in a wide variety of Color Temperature (CCT), FLUX, and CRI. Highly efficient and consistent color maintained to 3 SDMC for color critical applications. B50/L70 and compliant with Zhaga recognized hole patterns. Consult factory for LED options or configurations not listed below.

DRIVERS: Standard Universal Voltage Class 2 drivers are 0-10v Dimmable to 1% for most LED configurations, and rated -20C (-4F). They come with at least 2.5Kv surge protection, have less than 10% THD at max load, Ballast Factor Greater than .95 and are programmable to match specific lumen or wattage requirements. Drivers with higher input voltage ratings are available, consult factory for driver specifications.

REFLECTOR: Die formed metal with high reflectance white polyester powder coat finish. Typical reflectivity 92%.

INSTALL RECESSED: One fixture suitable for Grid and Flanged installation. Accommodates 1" and 1.5" T-Bar Grid (Consult factory for 2" T-Bar Grid compatibility). Four adjustable toggle arms with holes for seismic support wire attachment. Supply entry via 1/2" trade size flattened knockouts.

INSTALL SURFACE: Four .312" dia.mounting holes and a removable gasketed wiring access plate with Supply entry via 1/2" trade size flattened knockouts.

FINISH: Gloss white high reflectance 1000 hr. salt spray polyester powder coat finish standard for all recessed housings. Stainless steel doorframes and surface housings are satin polished unless option WHT is chosen.

LISTINGS: IP66 rated for dust and water ingress. Suitable for 1700 PSI high pressure hosedowns. ETL listed per UL_1598 for wet locations. Chicago Plenum Rated. Certified ISO-14644-1 for class 3 through class 9 cleanspaces. Certified Fed Std 209E for Class 1 through Class 100,000 cleanspaces. NSF2 Listed for Food Zones. Drivers and LEDs are covered by a 5 year warranty, the remaining fixture is covered by a 10 year warranty.

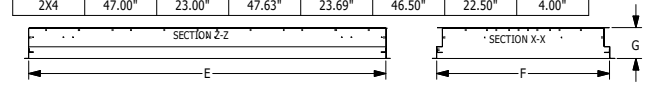
PRODUCT DRAWINGS

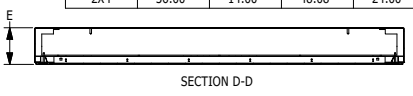
"R" HOUSING REFERENCE DIMENSIONS

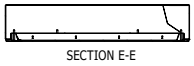
SIZE	A	B	C	D	E	F	G
1X4	47.00"	11.00"	47.63"	11.69"	46.50"	10.50"	4.00"
2X2	23.00"	23.00"	23.63"	23.69"	22.50"	22.50"	4.00"
2X4	47.00"	23.00"	47.63"	23.69"	46.50"	22.50"	4.00"

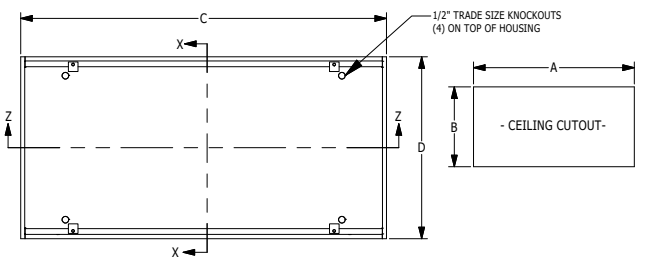
"S" REFERENCE DIMENSIONS

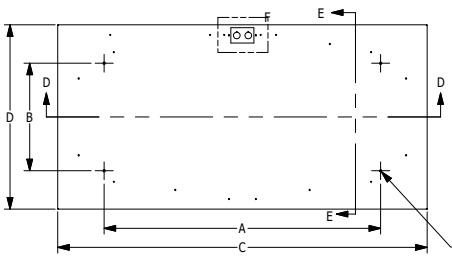
SIZE	DIM A	DIM B	DIM C	DIM D	DIM E
1X4	43.00"	4.75"	48.08"	12.00"	4.75"
2X2	12.00"	14.00"	24.08"	24.00"	4.75"
2X4	36.00"	14.00"	48.08"	24.00"	4.75"

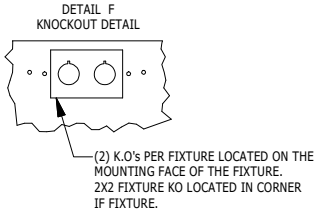












KURTZON
SPECIFICATION GRADE LIGHTING
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REV: 10/08/2019

Cleanroom **KL Troffers**

1x4, 2x2 and 2x4 High Efficiency LED Luminaires

ENERGY DATA

OVERLAP-FGRS-LED TROFFER (APPROX[1] LUMENS DELIVERED)										
ENCLOSURE SIZE	LIGHT PACKAGE	83 CRI (3000K - 5000K)				90 CRI (3500K, 4000K)				STANDARD DIMMING
		LUMENS	WATTS[2]	EFFICACY[3]	MAX AMB TEMP	LUMENS	WATTS[2]	EFFICACY[3]	MAX AMB TEMP[4]	
1X4	1LEDR	4,100	37	110	40°C (104°F)	2,880	34	85	40°C (104°F)	0-10V 1%
1X4	2LEDR	**8,324**	73	114	40°C (104°F)	5,777	62	93	40°C (104°F)	0-10V 1%
1X4	2LEDH	**12,642**	103	123	40°C (104°F)	12,449	146	85	35°C (95°F)	0-10V 1%
1X4	2LEDHF	15,800	139	114	35°C (95°F)	15,546	182.5	85.2	35°C (95°F)	0-10V 1%
1X4	EM10	1060-1140	4	NA	40°C (104°F)	850-930	4	NA	40°C (104°F)	NA
2X2	2LEDR	4,450	37	119	40°C (104°F)	2,746	32	86	40°C (104°F)	0-10V 1%
2X2	3LEDR	6,670	55	121	40°C (104°F)	4,182	48	87	40°C (104°F)	0-10V 1%
2X2	2LEDH	6,500	51	127	40°C (104°F)	5,251	73	72	35°C (95°F)	0-10V 1%
2X2	4LEDR	**8,897**	73	122	40°C (104°F)	5,221	62	84	40°C (104°F)	0-10V 1%
2X2	3LEDH	9,880	77	129	40°C (104°F)	8,343	110	76	35°C (95°F)	0-10V 1%
2X2	4LEDH	**12,846**	102	126	40°C (104°F)	10,519	146	72	35°C (95°F)	0-10V 1%
2X2	4LEDHF	**19,652**	171	115	35°C (95°F)	NA	NA	NA	NA	0-10V 5%
2X2	4LEDHF (1%)	**15,724**	138	114	35°C (95°F)	16,425	183.8	89.4	35°C (95°F)	0-10V 1%
2X2	EM10	950-1150	4	NA	40°C (104°F)	720-870	4	NA	40°C	NA
2X4	2LEDR	9,180	74	124	40°C (104°F)	6,528	62	105	40°C (104°F)	0-10V 1%
2X4	3LEDR	13,770	111	124	40°C (104°F)	9,797	94	104	40°C (104°F)	0-10V 1%
2X4	2LEDH	14,340	103	139	40°C (104°F)	12,949	148	88	35°C (95°F)	0-10V 1%
2X4	4LEDR	**18,370**	147	125	40°C (104°F)	12,762	124	103	40°C (104°F)	0-10V 1%
2X4	3LEDH	21,060	153	138	40°C (104°F)	19,549	221	88	35°C (95°F)	0-10V 1%
2X4	4LEDH	**27,597**	208	133	40°C (104°F)	25,898	295	88	35°C (95°F)	0-10V 1%
2X4	4LEDHF	**35,352**	279	127	35°C (95°F)	35,488	373.3	95.1	35°C (95°F)	0-10V 1%
2X4	EM10	1180-1270	4	NA	40°C (104°F)	880-1050	4	NA	40°C	NA

[1] DELIVERED LUMEN DATA IS EXTRAPOLATED FROM MEASURED DATA @25C WITH NO EXTRA OPTIONS. VARIANCES WILL OCCUR WHEN OPTIONS ARE CHOSEN

[2] WATTAGE IS MEASURED WITH 4000K SELECTION @ 120vAC AND Tambient = 25C. WATTAGES MAY VARY WITH ALTERNATE CONFIGURATIONS

[3] EFFICACY CALCULATED USING 4000K CCT DATA.

[4] MAX AMBIENT TEMP RATING, NON-IC INSTALLATON. TEMP RATING MAY VARY WITH SPECIFIED DRIVERS OR ANY NON STANDARD SELECTION

[5] 90 MINUTE 10W EMERGENCY DRIVER; LUMENS CALCULATED BASED ON FIXTURE EFFICACY.

PHOTOMETRICS

KL-R-X-2X4-4/LEDHF-835-UNV

Report No: 19675

Total Lumens: 35,352

Wattage: 278.7

Efficacy: 126.8 (Lumens Per Watt)

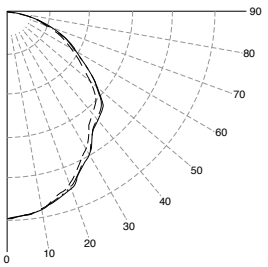
Fixture Size: 2'x4'

Key:

0

45

90



KL-R-X-2X2-4/LEDHF-840-UNV

Report No: 19692

Total Lumens: 19,652

Wattage: 171.32

Efficacy: 114.7 (Lumens Per Watt)

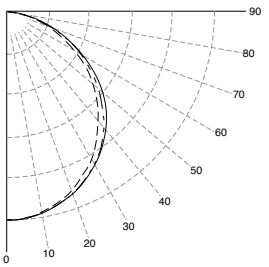
Fixture Size: 2'x2'

Key:

0

45

90



KL-R-5-1X4-2/LEDH-840-UNV

Report No: 20898

Total Lumens: 12,642

Wattage: 102.43

Efficacy: 123.4 (Lumens Per Watt)

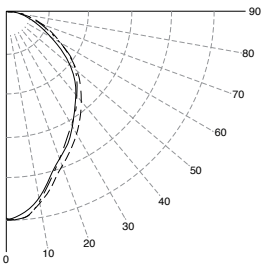
Fixture Size: 1'x4'

Key:

0

45

90



KURTZON
SPECIFICATION GRADE LIGHTING
ILLUMINATING YOUR WORLD

PROJECT 21940-MH Main Pharmacy 2nd Flr
DATE
TYPE F1D-20W
NOTES KL R 3 2X2 2/LEDR 835 UNV WHT P20W

REV: 10/08/2019

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KL							

Series	Installation Type	Material	Size	Source	CCT	Voltage	Options
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		4: White AL Hsg. & Polished 304 SS Door		**2/LEDR**	**830** = 3000K CCT	**277V**	**2/ED**: Two Drivers (Two Circuits)
		5: White AL Hsg. & White AL Door		**2/LEDH**	**835** = 3500K CCT	**UNV**	**EDL:** -40F Electronic Driver
		7: White AL Hsg. & White CRS Door -		**2/LEDHF**	**840** = 4000K CCT	**347V***	**EM10:** 10W Integral LED EM (Specify Input Voltage)
			2x2: 2' x 2' Housing	**2/LEDR**	**850** = 5000K CCT		**EM20:** 20W Remote LED EM (Specify Input Voltage)
			OR	**2/LEDH**			**WHT:** White Finished Door & HSG
			2x4: 2' x 4' Housing	**3/LEDR**	**90+ CRI:**		**LEX:** .125" Prismatic Polycarbonate
				3/LEDH	**935** = 3500K CCT		**A19**: .156" Prismatic P19 Pattern Clear Acrylic
				4/LEDR	**940** = 4000K CCT		**HIA:** .140" High Impact P12 Pattern Clear Acrylic
				4/LEDH	**950** = 5000K CCT		**TG:** .156" Prismatic Tempered Glass
				4/LEDHF			**SW:** Wet Locatoin Hub Supplied (not installed)
	S: Surface	**1:** White CRS Hsg. & White CRS Door	**1x4**: 1' x 4' Housing	**1/LEDR**			**PxL:** Programmed to User Specified Lumen Value.
		2: White CRS Hsg. & Polished 304 SS Door		**2/LEDR**			**PxW:** Programmed to User Specified Wattage Value.
		3: Polished 304 SS Hsg. & Polished 304 SS Door		**2/LEDH**			**10KV:** 10KV Parallel Surge Protection (One Supplied Per Circuit)
		4: White AL Hsg. & Polished 304 SS Door		**2/LEDHF**			**GTD:** Generator Transfer Device
		5: White AL Hsg. & White AL Door	**2x2**: 2' x 2' Housing	**2/LEDR**			**WHIP:** Must Specify Length and Wire Qty
		6: White CRS Hsg. & White AL Door	OR	**2/LEDH**			**.125 FROST**: 1/8" Frost Acrylic Lens
		7: White AL Hsg. & White CRS Door	**2x4:** 2' x 4' Housing	**3/LEDR**			**HF1:** 1% Dimming for 2x2 with LEDHF
				3/LEDH			**OCCMW:** Internal microwave OCC Sensor
				4/LEDR			
				4/LEDH			
				4/LEDHF			

KURTZON
SPECIFICATION GRADE LIGHTING
ILLUMINATING YOUR WORLD

REV: 10/08/2019

Cleanroom **KL Troffers**

1x4, 2x2 and 2x4 High Efficiency LED Luminaires

SPECIFICATIONS

HOUSING: One piece, hole free, robotically seam welded housing has flattened knockouts for a superior seal. Recessed housings are available in .040" 3003 Aluminum or 20Ga 430 Stainless Steel. Surface housings are available in .050" 3003 Aluminum, 18Ga 304 Stainless Steel, or 20Ga Cold Rolled Steel.

DOOR FRAME: One piece door frame with welded corners overlaps the fixture allowing the NSF approved microcellular gasket to seal to the mounting surface. Door frame is hinged by aircraft cables and is supplied with captive stainless steel flush head screws to allow easy wiping of the surface. Available in .050" 3003 Powder coated Alum., 20Ga 304 Polished SS, or 18Ga Powder coated CRS.

GASKETS: NSF Listed closed cell microcellular extruded KleanLock SealPro gasket with vulcanized corners making a one-piece oil and solvent resistant gasket system.

LENS: Impact resistant .135" thick virgin acrylic with P12 prismatic pattern inverted. Sealed to door with NSF listed RTV silicone. See "Options" for other choices.

LEDS: Commercially available in a wide variety of Color Temperature (CCT), FLUX, and CRI. Highly efficient and consistent color maintained to 3 SDMC for color critical applications. B50/L70 and compliant with Zhaga recognized hole patterns. Consult factory for LED options or configurations not listed below.

DRIVERS: Standard Universal Voltage Class 2 drivers are 0-10v Dimmable to 1% for most LED configurations, and rated -20C (-4F). They come with at least 2.5Kv surge protection, have less than 10% THD at max load, Ballast Factor Greater than .95 and are programmable to match specific lumen or wattage requirements. Drivers with higher input voltage ratings are available, consult factory for driver specifications.

REFLECTOR: Die formed metal with high reflectance white polyester powder coat finish. Typical reflectivity 92%.

INSTALL RECESSED: One fixture suitable for Grid and Flanged installation. Accommodates 1" and 1.5" T-Bar Grid (Consult factory for 2" T-Bar Grid compatibility). Four adjustable toggle arms with holes for seismic support wire attachment. Supply entry via 1/2" trade size flattened knockouts.

INSTALL SURFACE: Four .312" dia.mounting holes and a removable gasketed wiring access plate with Supply entry via 1/2" trade size flattened knockouts.

FINISH: Gloss white high reflectance 1000 hr. salt spray polyester powder coat finish standard for all recessed housings. Stainless steel doorframes and surface housings are satin polished unless option WHT is chosen.

LISTINGS: IP66 rated for dust and water ingress. Suitable for 1700 PSI high pressure hosedowns. ETL listed per UL_1598 for wet locations. Chicago Plenum Rated. Certified ISO-14644-1 for class 3 through class 9 cleanspaces. Certified Fed Std 209E for Class 1 through Class 100,000 cleanspaces. NSF2 Listed for Food Zones. Drivers and LEDs are covered by a 5 year warranty, the remaining fixture is covered by a 10 year warranty.

PRODUCT DRAWINGS

"R" HOUSING REFERENCE DIMENSIONS

SIZE	A	B	C	D	E	F	G
1X4	47.00"	11.00"	47.63"	11.69"	46.50"	10.50"	4.00"
2X2	23.00"	23.00"	23.63"	23.69"	22.50"	22.50"	4.00"
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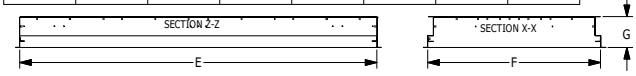

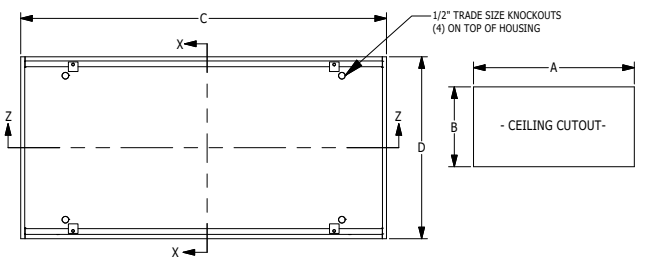

"S" REFERENCE DIMENSIONS

SIZE	DIM A	DIM B	DIM C	DIM D	DIM E
1X4	43.00"	4.75"	48.08"	12.00"	4.75"
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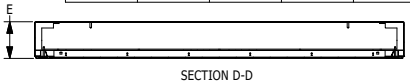
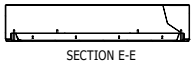
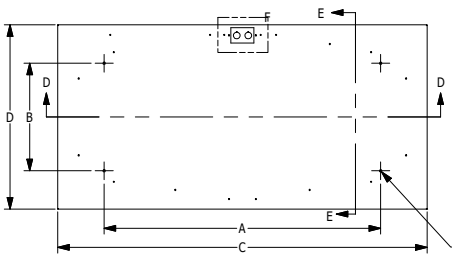
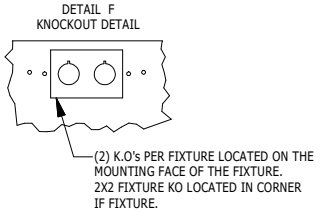








KURTZON
SPECIFICATION GRADE LIGHTING
ILLUMINATING YOUR WORLD

REV: 10/08/2019

Cleanroom **KL Troffers**

1x4, 2x2 and 2x4 High Efficiency LED Luminaires

ENERGY DATA

OVERLAP-FGRS-LED TROFFER (APPROX[1] LUMENS DELIVERED)										
ENCLOSURE SIZE	LIGHT PACKAGE	83 CRI (3000K - 5000K)				90 CRI (3500K, 4000K)				STANDARD DIMMING
		LUMENS	WATTS[2]	EFFICACY[3]	MAX AMB TEMP	LUMENS	WATTS[2]	EFFICACY[3]	MAX AMB TEMP[4]	
1X4	1LEDR	4,100	37	110	40°C (104°F)	2,880	34	85	40°C (104°F)	0-10V 1%
1X4	2LEDR	**8,324**	73	114	40°C (104°F)	5,777	62	93	40°C (104°F)	0-10V 1%
1X4	2LEDH	**12,642**	103	123	40°C (104°F)	12,449	146	85	35°C (95°F)	0-10V 1%
1X4	2LEDHF	15,800	139	114	35°C (95°F)	15,546	182.5	85.2	35°C (95°F)	0-10V 1%
1X4	EM10	1060-1140	4	NA	40°C (104°F)	850-930	4	NA	40°C (104°F)	NA
2X2	2LEDR	4,450	37	119	40°C (104°F)	2,746	32	86	40°C (104°F)	0-10V 1%
2X2	3LEDR	6,670	55	121	40°C (104°F)	4,182	48	87	40°C (104°F)	0-10V 1%
2X2	2LEDH	6,500	51	127	40°C (104°F)	5,251	73	72	35°C (95°F)	0-10V 1%
2X2	4LEDR	**8,897**	73	122	40°C (104°F)	5,221	62	84	40°C (104°F)	0-10V 1%
2X2	3LEDH	9,880	77	129	40°C (104°F)	8,343	110	76	35°C (95°F)	0-10V 1%
2X2	4LEDH	**12,846**	102	126	40°C (104°F)	10,519	146	72	35°C (95°F)	0-10V 1%
2X2	4LEDHF	**19,652**	171	115	35°C (95°F)	NA	NA	NA	NA	0-10V 5%
2X2	4LEDHF (1%)	**15,724**	138	114	35°C (95°F)	16,425	183.8	89.4	35°C (95°F)	0-10V 1%
2X2	EM10	950-1150	4	NA	40°C (104°F)	720-870	4	NA	40°C	NA
2X4	2LEDR	9,180	74	124	40°C (104°F)	6,528	62	105	40°C (104°F)	0-10V 1%
2X4	3LEDR	13,770	111	124	40°C (104°F)	9,797	94	104	40°C (104°F)	0-10V 1%
2X4	2LEDH	14,340	103	139	40°C (104°F)	12,949	148	88	35°C (95°F)	0-10V 1%
2X4	4LEDR	**18,370**	147	125	40°C (104°F)	12,762	124	103	40°C (104°F)	0-10V 1%
2X4	3LEDH	21,060	153	138	40°C (104°F)	19,549	221	88	35°C (95°F)	0-10V 1%
2X4	4LEDH	**27,597**	208	133	40°C (104°F)	25,898	295	88	35°C (95°F)	0-10V 1%
2X4	4LEDHF	**35,352**	279	127	35°C (95°F)	35,488	373.3	95.1	35°C (95°F)	0-10V 1%
2X4	EM10	1180-1270	4	NA	40°C (104°F)	880-1050	4	NA	40°C	NA

[1] DELIVERED LUMEN DATA IS EXTRAPOLATED FROM MEASURED DATA @25C WITH NO EXTRA OPTIONS. VARIANCES WILL OCCUR WHEN OPTIONS ARE CHOSEN

[2] WATTAGE IS MEASURED WITH 4000K SELECTION @ 120vAC AND Tambient = 25C. WATTAGES MAY VARY WITH ALTERNATE CONFIGURATIONS

[3] EFFICACY CALCULATED USING 4000K CCT DATA.

[4] MAX AMBIENT TEMP RATING, NON-IC INSTALLATON. TEMP RATING MAY VARY WITH SPECIFIED DRIVERS OR ANY NON STANDARD SELECTION

[5] 90 MINUTE 10W EMERGENCY DRIVER; LUMENS CALCULATED BASED ON FIXTURE EFFICACY.

PHOTOMETRICS

KL-R-X-2X4-4/LEDHF-835-UNV

Report No: 19675

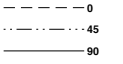
Total Lumens: 35,352

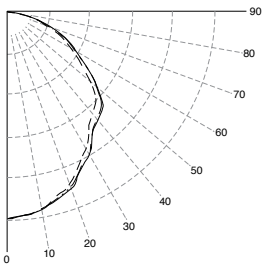
Wattage: 278.7

Efficacy: 126.8 (Lumens Per Watt)

Fixture Size: 2'x4'

Key:





KL-R-X-2X2-4/LEDHF-840-UNV

Report No: 19692

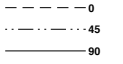
Total Lumens: 19,652

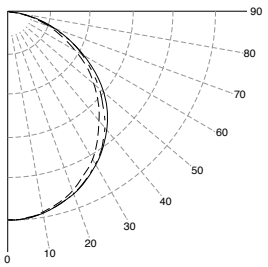
Wattage: 171.32

Efficacy: 114.7 (Lumens Per Watt)

Fixture Size: 2'x2'

Key:





KL-R-5-1X4-2/LEDH-840-UNV

Report No: 20898

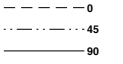
Total Lumens: 12,642

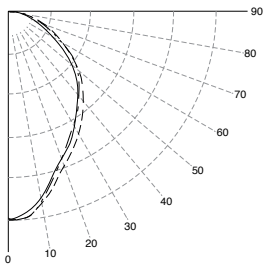
Wattage: 102.43

Efficacy: 123.4 (Lumens Per Watt)

Fixture Size: 1'x4'

Key:





KURTZON
SPECIFICATION GRADE LIGHTING
ILLUMINATING YOUR WORLD

PROJECT 21940-MH Main Pharmacy 2nd Flr
DATE
TYPE F1D-20W
NOTES KL R 3 2X2 2/LEDR 835 UNV WHT P20W

REV: 10/08/2019

Cleanroom **KL Troffers**

1x4, 2x2 and 2x4 High Efficiency LED Luminaires

- **Rated IP66**
- **Suitable for ISO 3-9 Cleanspaces**
- **Suitable for 209E class 1-100,000 Cleanspaces**
- **ETL listed for Wet Locations**
- **One piece overlapping doorframe**
- **Robotically seam welded housing**
- **0-10V 1% dimming comes standard (except 2x2 with HF LED Selection)**
- **Up to 35,000 Lm Delivered @127 Lm/W**
- **DLC Standard and Premium Listings Available**
- **Recessed Housing suitable for Tbar Grid AND Hardlid Installations**
- **Made in the USA by a Family Owned US Corporation**

To See All DLC Listings, Visit www.Kurtzon.com/DLC

ORDERING GUIDE

Series	Installation Type	Material	Size	Source	CCT	Voltage	Options
KL							

Series	Installation Type	Material	Size	Source	CCT	Voltage	Options
KL	**R**: Recessed (Suitable for Flange & Grid)	**3**: White 430 SS Hsg. & Polished 304 SS Door	**1x4**: 1' x 4' Housing	**1/LEDR**	**83 CRI:**	**120V**	**FC:** Fuse & Holder (One Supplied Per Circuit)
		4: White AL Hsg. & Polished 304 SS Door		**2/LEDR**	**830** = 3000K CCT	**277V**	**2/ED**: Two Drivers (Two Circuits)
		5: White AL Hsg. & White AL Door		**2/LEDH**	**835** = 3500K CCT	**UNV**	**EDL:** -40F Electronic Driver
		7: White AL Hsg. & White CRS Door -		**2/LEDHF**	**840** = 4000K CCT	**347V***	**EM10:** 10W Integral LED EM (Specify Input Voltage)
			2x2: 2' x 2' Housing	**2/LEDR**	**850** = 5000K CCT		**EM20:** 20W Remote LED EM (Specify Input Voltage)
			OR	**2/LEDH**			**WHT:** White Finished Door & HSG
			2x4: 2' x 4' Housing	**3/LEDR**	**90+ CRI:**		**LEX:** .125" Prismatic Polycarbonate
				3/LEDH	**935** = 3500K CCT		**A19**: .156" Prismatic P19 Pattern Clear Acrylic
				4/LEDR	**940** = 4000K CCT		**HIA:** .140" High Impact P12 Pattern Clear Acrylic
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		3: Polished 304 SS Hsg. & Polished 304 SS Door		**2/LEDH**			**10KV:** 10KV Parallel Surge Protection (One Supplied Per Circuit)
		4: White AL Hsg. & Polished 304 SS Door		**2/LEDHF**			**GTD:** Generator Transfer Device
		5: White AL Hsg. & White AL Door	**2x2**: 2' x 2' Housing	**2/LEDR**			**WHIP:** Must Specify Length and Wire Qty
		6: White CRS Hsg. & White AL Door	OR	**2/LEDH**			**.125 FROST**: 1/8" Frost Acrylic Lens
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				3/LEDH			**OCCMW:** Internal microwave OCC Sensor
				4/LEDR			
				4/LEDH			
				4/LEDHF			

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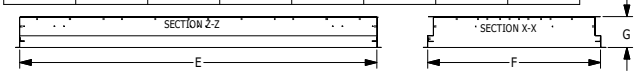

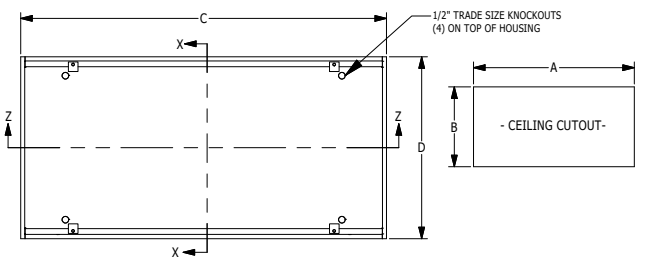

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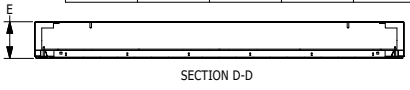

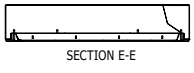

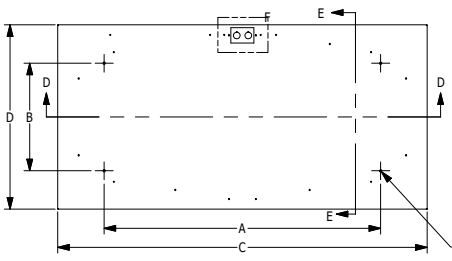

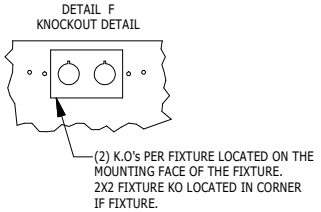

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ENCLOSURE SIZE	LIGHT PACKAGE	83 CRI (3000K - 5000K)				90 CRI (3500K, 4000K)				STANDARD DIMMING
		LUMENS	WATTS[2]	EFFICACY[3]	MAX AMB TEMP	LUMENS	WATTS[2]	EFFICACY[3]	MAX AMB TEMP[4]	
1X4	1LEDR	4,100	37	110	40°C (104°F)	2,880	34	85	40°C (104°F)	0-10V 1%
1X4	2LEDR	**8,324**	73	114	40°C (104°F)	5,777	62	93	40°C (104°F)	0-10V 1%
1X4	2LEDH	**12,642**	103	123	40°C (104°F)	12,449	146	85	35°C (95°F)	0-10V 1%
1X4	2LEDHF	15,800	139	114	35°C (95°F)	15,546	182.5	85.2	35°C (95°F)	0-10V 1%
1X4	EM10	1060-1140	4	NA	40°C (104°F)	850-930	4	NA	40°C (104°F)	NA
2X2	2LEDR	4,450	37	119	40°C (104°F)	2,746	32	86	40°C (104°F)	0-10V 1%
2X2	3LEDR	6,670	55	121	40°C (104°F)	4,182	48	87	40°C (104°F)	0-10V 1%
2X2	2LEDH	6,500	51	127	40°C (104°F)	5,251	73	72	35°C (95°F)	0-10V 1%
2X2	4LEDR	**8,897**	73	122	40°C (104°F)	5,221	62	84	40°C (104°F)	0-10V 1%
2X2	3LEDH	9,880	77	129	40°C (104°F)	8,343	110	76	35°C (95°F)	0-10V 1%
2X2	4LEDH	**12,846**	102	126	40°C (104°F)	10,519	146	72	35°C (95°F)	0-10V 1%
2X2	4LEDHF	**19,652**	171	115	35°C (95°F)	NA	NA	NA	NA	0-10V 5%
2X2	4LEDHF (1%)	**15,724**	138	114	35°C (95°F)	16,425	183.8	89.4	35°C (95°F)	0-10V 1%
2X2	EM10	950-1150	4	NA	40°C (104°F)	720-870	4	NA	40°C	NA
2X4	2LEDR	9,180	74	124	40°C (104°F)	6,528	62	105	40°C (104°F)	0-10V 1%
2X4	3LEDR	13,770	111	124	40°C (104°F)	9,797	94	104	40°C (104°F)	0-10V 1%
2X4	2LEDH	14,340	103	139	40°C (104°F)	12,949	148	88	35°C (95°F)	0-10V 1%
2X4	4LEDR	**18,370**	147	125	40°C (104°F)	12,762	124	103	40°C (104°F)	0-10V 1%
2X4	3LEDH	21,060	153	138	40°C (104°F)	19,549	221	88	35°C (95°F)	0-10V 1%
2X4	4LEDH	**27,597**	208	133	40°C (104°F)	25,898	295	88	35°C (95°F)	0-10V 1%
2X4	4LEDHF	**35,352**	279	127	35°C (95°F)	35,488	373.3	95.1	35°C (95°F)	0-10V 1%
2X4	EM10	1180-1270	4	NA	40°C (104°F)	880-1050	4	NA	40°C	NA

[1] DELIVERED LUMEN DATA IS EXTRAPOLATED FROM MEASURED DATA @25C WITH NO EXTRA OPTIONS. VARIANCES WILL OCCUR WHEN OPTIONS ARE CHOSEN

[2] WATTAGE IS MEASURED WITH 4000K SELECTION @ 120vAC AND Tambient = 25C. WATTAGES MAY VARY WITH ALTERNATE CONFIGURATIONS

[3] EFFICACY CALCULATED USING 4000K CCT DATA.

[4] MAX AMBIENT TEMP RATING, NON-IC INSTALLATON. TEMP RATING MAY VARY WITH SPECIFIED DRIVERS OR ANY NON STANDARD SELECTION

[5] 90 MINUTE 10W EMERGENCY DRIVER; LUMENS CALCULATED BASED ON FIXTURE EFFICACY.

PHOTOMETRICS

KL-R-X-2X4-4/LEDHF-835-UNV

Report No: 19675

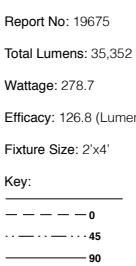
Total Lumens: 35,352

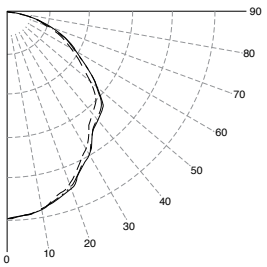
Wattage: 278.7

Efficacy: 126.8 (Lumens Per Watt)

Fixture Size: 2'x4'

Key:





KL-R-X-2X2-4/LEDHF-840-UNV

Report No: 19692

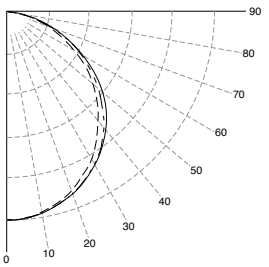
Total Lumens: 19,652

Wattage: 171.32

Efficacy: 114.7 (Lumens Per Watt)

Fixture Size: 2'x2'

Key:



KL-R-5-1X4-2/LEDH-840-UNV

Report No: 20898

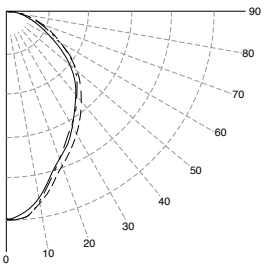
Total Lumens: 12,642

Wattage: 102.43

Efficacy: 123.4 (Lumens Per Watt)

Fixture Size: 1'x4'

Key:



PROJECT INFORMATION
Job Name 21940-MH Main Pharmacy 2nd Flr
Fixture Type Type F14CR
Catalog Number CMEXR 5F R DT NT EL
Approved by

SIMPLESEAL™

CMEXR SERIES

PRODUCT FEATURES:

» Recessed wall mount – Single Face
» Indirect Red or Green LED
» Self diagnostic testing features
» One-piece seam welded housing
» 304 stainless steel overlapping doorframe

SPECIFICATIONS

HOUSING: 20-gauge CRS standard – see ordering information. Hole-free one-piece seam welded construction. White TGIC polyester powder coat finish – 5 step pre-treatment. Salt spray test: 1,000 hours; Reflectance: 92%.

DOORFRAME: 20-gauge type 304 stainless steel (#4 finish-post fabrication) standard – see ordering information. One-piece 60° beveled perimeter construction. Continuous angle lens retention system. Mechanical guide for doorframe fastener alignment. Doorframe secured to housing with 4 captive flush mounted Phillips head stainless steel fasteners.

DOORFRAME GASKET: One-piece closed cell extruded silicone gasket seals doorframe to housing and wall structure.

LENS: .125" clear polycarbonate lens sealed to perimeter ledge of lens aperture with silicone sealant and secured with continuous lens retention system.

LEGEND: Legend illuminated by internal high output LEDs. Lettering six inches high with .750" stroke. Polycarbonate red or green filter panels. High impact, punched, formed and painted sheet metal stencil and field selectable chevron inserts.

ELECTRICAL: 624 nm Red or 527 nm Green LED light source. Electrical components mounted to removable high impact, injection molded polycarbonate chassis. Exit Ready – can power one Kenall METSS Satellite Exit.

OPTIONS: Sealed nickel-cadmium Emergency Battery Pack (EL) with standard deep cycle battery conditioning, self test and self diagnostic circuitry, remote laser activated test switch, protected mechanical test switch and status indicator. Provides 120 minutes of emergency operation. Emergency Battery Pack (EL) suitable for 10°C to 45°C (50°F to 113°F). Cold Weather Emergency Battery Pack (CEL) suitable for -45°C to 45°C (-49°F to 113°F). (When used with a Kenall METSS, this fixture provides 90 minutes of emergency operation.)

LISTINGS: UL and CUL Listed for Wet Location. UL certified IP65 per IEC 60598. NSF2 Splash/Non-Food Zone. Meets or exceeds UL924 and NFPA 101 standards. Meets or exceeds CSA and NRCAN requirements. FED-STD-209E/Class 100 (ISO 5) Cleanrooms.

LED c UL us IP65 NSF UL 924 NFPA 101 ISO 5 Class 100

ORDERING INFORMATION (Ex: CMEXR-5F-R-DT-NT-EL)

Model	Frame Material	Legend Color	Voltage	Mounting	Options	Accessories
CMEXR						

Frame Material
5F 20-Ga Type 304 SS (STD)
2F 20-Ga CRS Painted White
XF 20-Ga Type 316 SS

Legend Color
G Green
R Red

Voltage
DT 120/277 Volts
DTC 120/347 Volts

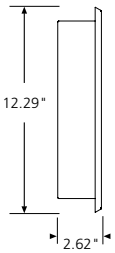
Mounting
NT Recessed Mounting Tray for new construction; fits16" stud spacing, 5/8" wall thickness (tray is mounted before drywall installed)
RT Recessed Retrofit Mounting Tray for existing construction; 10.75"×14.5" opening required

Options
CEL Cold Weather Emergency Battery Pack
EL Standard Emergency Battery Pack
BEF Black Exit Face for 5F or XF SS Frame
BLK Black Exterior CRS Frame and Exit Face
XAC Auxiliary AC Supply (matches voltage selection)
XDC Auxiliary DC Supply (6-24 volts)

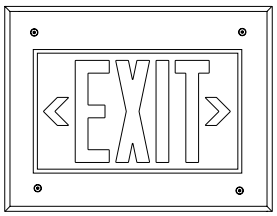
Accessory
LP Laser Pointer

DIMENSIONAL DATA

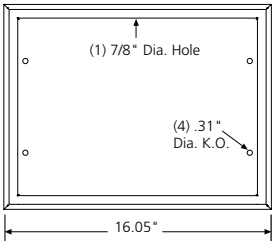
Side View



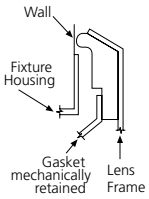
Face View



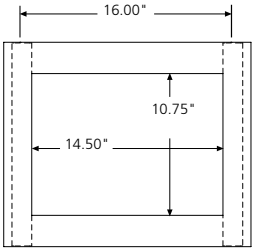
Back View



Gasket Profile



Stud Spacing 16" /Rough Opening 10.75" × 14.50"
Wall Thickness 5/8"



Catalog Number	
Notes	Type

TYPE EXIT-2W

Description:
The Encore Endurance CX Series is a recessed mounted LED Edgelit sign utilizing two adjustable high brightness 1 1/2 watt White LED MR16 type lamps for code approved downlighting. A crystal clear acrylic panel hangs from the trim plate providing a slim, nearly invisible aesthetic sign. The LED EXIT illuminator uses ultra high brightness Piranha type RED LED's providing bright, consistent illumination. The two LED MR16 downlights provide up to 10 foot candles on the floor, below the sign. The unit utilizes high temperature NiCad batteries to provide 90 minutes of lighted sign and downlight during power failures. The recessed housing has adjustable mounting bars to allow proper ceiling fit in any application.

Electrionics:
The unit accepts input of 120 or 277 VAC, 60 Hz. Power consumption is 1.9 watts and uses NiCad batteries. Charging is accomplished with a constant current charger capable of recharging as per UL924 standard. No mechanical relays are used, transfer is accomplished using solid-state circuitry.

Housing:
Recessed housing is constructed of 18 gauge galvanized steel. All electronics, including the battery, are mounted and prewired in the housing allowing for complete wiring prior to the installation of the panel/trim assembly. The electronics are mounted on a removable sub-chassis to facilitate mounting and maintenance. The recessed housing is provided with vertically adjustable mounting bars allowing for a proper flush ceiling fit. 1/2" conduit knockouts are included on both sides as well as on top of the housing.

LED Exit Illuminator:
The LED illuminator consists of 10 Ultra bright Piranha Red LEDs. The Piranha LED has nearly 180 degree emitting angle allowing for even illumination. The LEDs are wired in sets of two, insuring in the unlikely event of a single LED failure, the sign will continue to be illuminated.

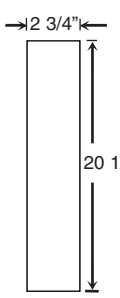
LED MR16 Downlights:
The Endurance CX utilizes (2) ultra high brightness White LED MR16 type lamps. Each LED lamp is housed in an MR16 type lamp, of die cast construction for heat dissipation. Each LED MR16 lamp is adjustable 35° and will provide a minimum of 5 fc to meet Local Law 16/41 illumination requirements.

Trim/Panel Assembly:
The Trim/Panel assembly consists of two die formed clear acrylic attached to an extruded aluminum trim plate. The panel assembly consists of panel halves ultrasonically welded together, no hardware is visible. The Trim/Panel is attached to the housing using invisible torsion springs, no hardware is visible. The "EXIT" letters are silk screened onto the acrylic, using a LED frequency matched paint. Each letter is outlined with a 1/8" groove. The standard trim finish is Brushed Aluminum, bright dipped to stop noticeable finger prints. Other trim finishes are available, see ordering chart below.

Approvals/Warranty:
UL 924 listed, Life safety NFPA 101,NEC/OSHA, New York City approved. LED illuminator and MR16 LED lamps are warranted for 25 years. Charger covered by 3 year warranty. Nicad batteries covered by 10 year warranty, 3 years complete, 7 years prorated.

ENDURANCE
CX SERIES

Combo Edgelit Exit
LED Exit
Recessed LED Downlights



Ceiling
Wall
Cutout

Universal arrows allow flexible field selection.

NiCad Batteries.

25 years LED Lamps.

25 years EXIT LED Downlights.

18 gauge galvanized steel, recessed housing is vertically adjustable.

Dual 120/277 VAC, 60 Hz input.

Invisible torsion springs secure trim plate to housing.

Adjustable hanger bars.

ORDERING INFORMATION
SAMPLE CAT#: ??????????????????????????????

PER ARCHITECT

Operation	No of Faces	Letter Size	Letter/Panel	Trim Finish	Arrow Direction
CX Series	1 Single	6	RC Red/Clear	A Br. Aluminum	AL Arrow Left
	2 Double	8	RW Red/White	PA Pol. Aluminum	AR Arrow Right
			RM Red/Mirror	PB Pol. Brass	LR Double Faced Arrows
			GC Green/Clear	BZ Bronze	DH Double Headed Arrows
			GW Green/White	B Black	U Universal Arrows
			GM Green/Mirror	W White	

AS SHOWN ON RCP

Trim and Panel Only (Recessed) Add Prefix "T"

Housing Only (Recessed) HCX Battery Housing

Office: 718-418-5600 • Fax: 718-418-5618
57-10 49th Place • Maspeth, N.Y. 11378
www.encorelighting.com

LAMARLED

TYPE F12-19W

The LVL series is powered by state of the art LED technology and is ideal for applications such as offices, hospitals and schools.

LVL recessed lensed luminaire

Features and Specifications:

Construction:
- High reflectance components deliver main beam focus through the high transmission frosted acrylic lens
- Suitable for use in inverted T-Bar grid ceilings
- Integral grid clips

Size Options:
- Available in 2x2 and 2x4 sizes

Listing & Ratings:
- All electrical components are U.L. listed or recognized
- All fixtures are U.L. Certified and Union made in the
- USA Meets Buy America Act (ARRA)

Mounting Options:
- Recessed grid mount

Driver:
- Universal voltage 120-277V standard
- 0-10V or Lutron dimming optional
- Driver disconnect standard
- Custom driver tuning available for specific lumen requirements

Warranty:
- 5 years - part replacement only (see our terms & conditions page at www.lamarled.com for details)

See page 2 for dimensions & lumen data chart

Ordering Guide / Example

LVL22M-35D

LVL

EM'S AS REQUIRED.

Series	Size	Power	CCT	General Options
LVL = Angled Lensed LED	**22** = 2x2 **24** = 2x4	**L** = Low **M** = Medium **H** = High	**30** = 3000K **35** = 3500K **40** = 4000K **50** = 5000K	**EM** = Emergency pack >90 min., >500 lumens (higher output & run time available - consult factory) **D** = 0-10V dimming to 1% **DTD** = 0-10V Dim to Dark **LDH** = Lutron EcoSystem Hi-lume digital 1% w/Fade to Black **LD2** = Lutron 2-wire 120V 1% forward phase (40W max) **W** = 6ft Whip (dimming and/or EM leads included when necessary

Consult factory for additional options not shown or listed
Correlated Color Temperatures (CCTs) fall within the nominal range as per ANSI C78.377A

Project Information:

Job Name: _____ Fixture Type: _____

Catalog #: _____ Date: _____

Comments: _____

Certification & Listings:

UL CERTIFIED · 120-277V Universal · CRI 80+ · UNION MADE IN THE USA · RoHS COMPLIANT · 0-10V DIM · 5 YEAR WARRANTY

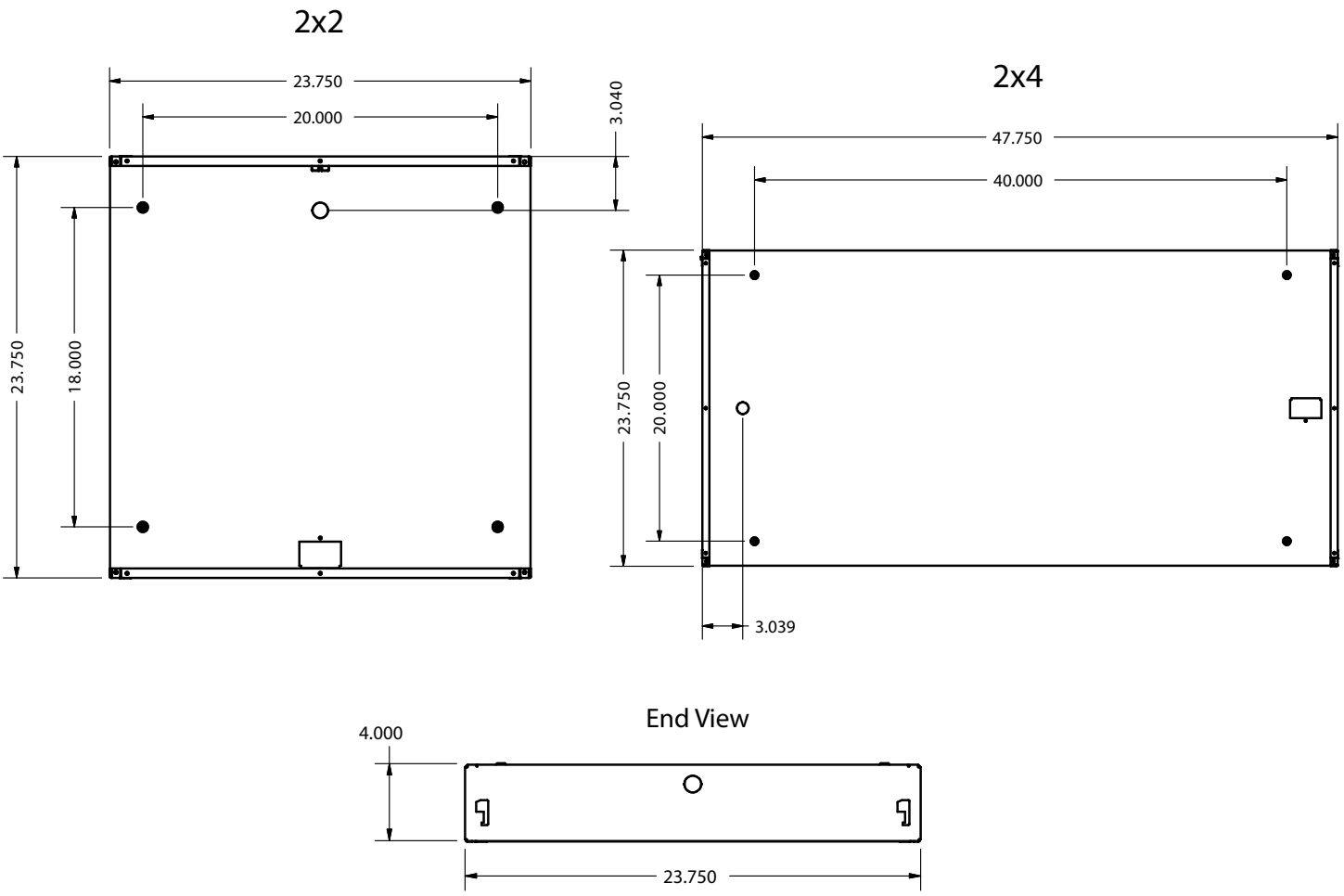
LAMARLED 1150 Motor Pkwy, Central Islip, NY 11722 | tel 631.777.7700 fax 516.333.7695 | www.lamarled.com

LAMARLED

LVL recessed lensed luminaire

BEFORE INSTALLATION, PLEASE CONSULT YOUR LOCAL ORDINANCES AND BUILDING CODES FOR COMPLIANCE

Dimensions



Lumen/Wattage Chart - 4000K

	Low	Medium	High
2x2	2197 Lu/19W	3037 Lu/26W	3814 Lu/32W
2x4	4065 Lu/34W	5441 Lu/45W	6754 Lu/57W

Lumen Multipliers	
3000K	0.952
3500K	0.968
5000K	1.03

LAMAR LED assumes no responsibility for misapplication of fixtures
Due to the rapid advancements in LED technology, please consult our website for the most current technical data.

Specifications subject to change without notice - Rev 0721

LAMARLED

TYPE F12-26W

The LVL series is powered by state of the art LED technology and is ideal for applications such as offices, hospitals and schools.

LVL recessed lensed luminaire

Features and Specifications:

Construction:

- High reflectance components deliver main beam focus through the high transmission frosted acrylic lens
- Suitable for use in inverted T-Bar grid ceilings
- Integral grid clips

Size Options:

- Available in 2x2 and 2x4 sizes

Listing & Ratings:

- All electrical components are U.L. listed or recognized
- All fixtures are U.L. Certified and Union made in the
- USA Meets Buy America Act (ARRA)

Mounting Options:

- Recessed grid mount

Driver:

- Universal voltage 120-277V standard
- 0-10V or Lutron dimming optional
- Driver disconnect standard
- Custom driver tuning available for specific lumen requirements

Warranty:

- 5 years - part replacement only (see our terms & conditions page at www.lamarled.com for details)

See page 2 for dimensions & lumen data chart

Ordering Guide / Example

LVL22M-35D

LVL

EM'S AS REQUIRED.

Series	Size	Power	CCT	General Options
LVL = Angled Lensed LED	**22** = 2x2 **24** = 2x4	**L** = Low **M** = Medium **H** = High	**30** = 3000K **35** = 3500K **40** = 4000K **50** = 5000K	**EM** = Emergency pack >90 min., >500 lumens (higher output & run time available - consult factory) **D** = 0-10V dimming to 1% **DTD** = 0-10V Dim to Dark **LDH** = Lutron EcoSystem Hi-lume digital 1% w/Fade to Black **LD2** = Lutron 2-wire 120V 1% forward phase (40W max) **W** = 6ft Whip (dimming and/or EM leads included when necessary

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Project Information:

Job Name: _____ Fixture Type: _____

Catalog #: _____ Date: _____

Comments: _____

Certification & Listings:

UL CERTIFIED · 120-277V Universal · CRI 80+ · UNION MADE IN THE USA · RoHS COMPLIANT · 0-10V DIM · 5 YEAR WARRANTY

LAMARLED 1150 Motor Pkwy, Central Islip, NY 11722 | tel 631.777.7700 fax 516.333.7695 | www.lamarled.com

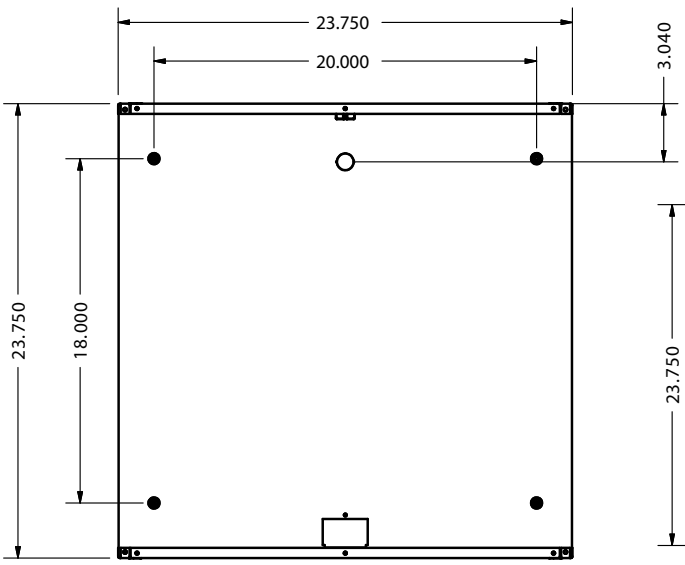
LAMARLED

LVL recessed lensed luminaire

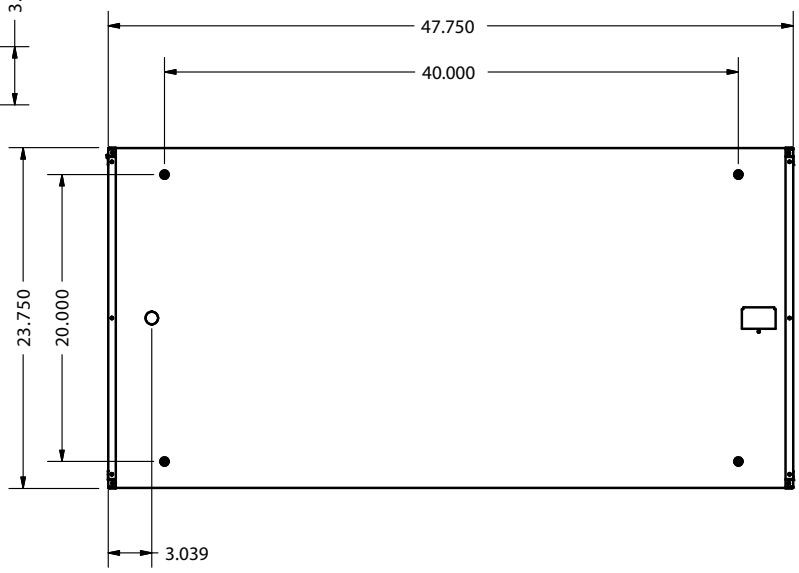
BEFORE INSTALLATION, PLEASE CONSULT YOUR LOCAL ORDINANCES AND BUILDING CODES FOR COMPLIANCE

Dimensions

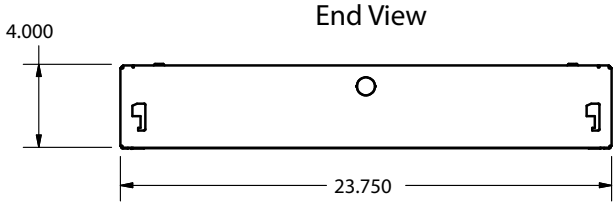
2x2



2x4



End View



Lumen/Wattage Chart - 4000K

	Low	Medium	High
2x2	2197 Lu/19W	3037 Lu/26W	3814 Lu/32W
2x4	4065 Lu/34W	5441 Lu/45W	6754 Lu/57W

Lumen Multipliers	
3000K	0.952
3500K	0.968
5000K	1.03

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Due to the rapid advancements in LED technology, please consult our website for the most current technical data.

Specifications subject to change without notice - Rev 0721

MECHANICAL TABLE OF CONTENTS - SPECIFICATIONS

END OF MECHANICAL TABLE OF CONTENTS

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 – GENERAL

1.1 REFER TO RELATED SECTIONS

Section 23 05 01 – Mechanical and Electrical Coordination
Section 23 05 02 – Basic Mechanical Requirements
Section 23 05 03 – Basic Mechanical Material and Methods
Section 22 10 00 – Piping and Equipment
Section 22 05 29 – Pipe Support and Anchors
Section 23 05 49 – Seismic Restraints
Section 22 05 53 – Plumbing Identification

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION 210500

SECTION 211300 - FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide a complete fire protection system as indicated on the Drawings and as specified herein consisting of the following but not limited thereto.

1. Complete sprinkler systems including relocations and connections to new and existing systems, sprinkler heads, all required accessories, etc.
2. Sleeve, hangers and supports.
3. Apply for, obtain and pay for all permits certificates, inspections and approvals required in connection with all Fire Protection Work.
4. Shop drawings: Shop drawings shall be produced in accordance with generally accepted standards for shop drawings and coordination drawings and shall be based on the Contractor's own field measurements. When a project is "phased" the Contractor shall anticipate that multiple filings may be required to allow permitting and approval of the project in a phased manner and shall prepare shop drawings and hydraulic calculations in packages matched to the final phasing plan.
5. Color coding and stenciling of all piping systems.
6. Cutting and rough and finish patching.
7. Prime and finish painting of all pipe risers and mains.
8. Hydrant flow tests unless recent data is specifically indicated on drawings and age of test data provided is acceptable to Authority Having Jurisdiction for duration of project.
9. Provide hydraulic calculations and drawings signed and sealed by a licensed professional engineer all as required by applicable Building Code, FM Global Referenced Standards, and N.F.P.A. Code. Contractor shall replace Engineer as Engineer of Record.
10. Provide ladders to all valves more than 8'-0" above finished floor.
11. Tests for all systems provided under this Section of the Specifications.
12. Where due to Union regulations or trade agreements, any of the work shown on the Drawings or specified herein is not considered Fire Protection Contractor's Work, this Contractor shall sub-contract the work in question, but this Contractor shall be held responsible for the complete installation.
13. It is not the intention of these Specifications to describe, nor the Contract Drawings to show in detail, all the various pieces of apparatus and appurtenances and their connections. This Contractor shall, as part of the Contract, furnish and install all incidentals, such as piping, fittings, valves, etc., required to complete the installation of the equipment. This Contractor shall refer to Architectural Drawings for exact location of devices including type and quantities. This Contractor shall be responsible for providing and connecting all fixtures and equipment.
14. All work described in these Specifications and not shown on the Drawings, or vice versa, shall be installed in a manner similar to the work shown or described.
15. Sprinkler drawings shall be reviewed and approved by insurance underwriters prior to installation.
16. Fire extinguishers.
17. All drains shall discharge to sanitary. Verify capability of existing drains to accept full flow discharge. If connection to sanitary sewer is determined to be infeasible or cost prohibitive, alternatives like splash blocks to prevent erosion (during discharging water to grade) may be considered.

B. It is the intent of this Specification for the Contractor to provide complete hydraulically designed wet pipe sprinkler systems for the areas indicated in these Specifications and shown on the Contract Drawings. This Contractor shall be the Engineer of record for the fire sprinkler system. Furnish all design, material, and labor to complete the contract within the intent of these Specifications and Contract Drawings even though each and every item necessary is not specifically mentioned or shown.

1.2 QUALITY ASSURANCE

A. Contractor Qualifications: Work shall be performed by a Contractor regularly engaged in the design and installation of fire protection systems in accordance with NFPA requirements and having at least ten years continuous experience in this type of work. Experience shall include projects of similar type, size and complexity.

B. Design Criteria: Provide fire protection systems of types, pressure, flow and densities required by regulatory agencies having jurisdiction.

1. Systems shall be calculated in a manner acceptable to regulatory agencies.
2. Contractor shall complete a hydrant test to confirm static and residual pressure for use in the hydraulic calculation. Contractor shall not assume that a prior hydrant test has been completed unless the test data is presented on the drawings. The Contractor shall complete all required hydrant tests or sub-contract this work to qualified testing parties.
3. Provide the following sprinkler head densities:
   .10 GPM/SQFT – Light Hazard
   .15 GPM/SQFT – Ordinary Hazard
4. Occupancy classification: Mixed – Light and Ordinary hazard.
5. Maximum sprinkler head spacing – based on NFPA Code: Light hazard- 225 sq.ft./sprinkler head. Ordinary hazard – 130 sq.ft./sprinkler head.
6. Calculations shall be based upon 1500 sq.ft. of the hydraulically most remote area of sprinkler operation for each system unless increased by dry systems or sloped ceiling. (30% increase for each condition).
7. Where source pressure allows, systems shall be sized for a minimum safety margin of 7 PSI. This margin is in addition to the 7 PSI code required minimum required at each head.
8. FM Global DOES NOT recognize NFPA's reduced demand area rules, and as such, they are not allowed for use in designing sprinkler systems.

C. Pipe sizes shown on drawings may be larger than minimum required. This is to accommodate additional partitioning which may occur in the future. Do not reduce sizes.

D. Requirements of Regulatory Agencies: Total system shall be acceptable upon completion and testing to the following:

1. Jurisdictional Code Enforcement Agencies
2. Jurisdictional Insurance Agency or Underwriter
3. Confirm requirements of the authority having jurisdiction and Owner's Insurance Underwriter prior to bid.

E. The Contractor shall give necessary notices, file drawings and specifications with the department having jurisdiction, obtain permits or licenses necessary to carry out this work and pay all fees therefore.

F. Certificate of Installation: Submit certificate upon completion of fire protection work, stating that the work has been completed and tested in accordance with the specified standards, that there are no defects in the system and it is operational.

G. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.

1.3 CODES AND STANDARDS

A. In addition to those specified in Section 21 05 02, comply with local fire department regulations and with the following:

1. Local Water Department
2. Local Building Department
3. New York State Building Code
4. Local Health Department
5. New York City Department of Buildings
6. NFPA 13, 14, 24, 231C
7. Local modifications to the Fire Codes
8. UL 508 Industrial Control Equipment
9. NFPA 70 National Electrical Code

B. All materials and equipment used in the installation of the fire protection system shall be as approved in the Underwriters' Laboratories list of inspected fire protection equipment and materials, or the Factory Mutual Laboratories list of approved equipment and fire protection devices involving fire hazard, and shall be the latest product of the manufacturer, and shall bear their label.

1.4 SUBMITTALS

A. Submittal data shall be in accordance with Division 1 and the following shall be submitted for review to the Architect prior to the start of installation.

B. Material and equipment information shall include catalog cuts and technical data for each system component or device. This shall include, but not be limited to piping, fittings, globe and angle valves, O.S.&Y valves, butterfly valves, check valves, automatic sprinkler heads, escutcheons, hangers, flow switches, and tamper switches.

C. Prepare shop drawings showing layout of fire protection system and piping. Use minimum scale of 3/8" = 1'-0" for floor plans. Drawings shall be based on the Contractors field measurements and information collected in coordination meetings, discussions and correspondence with other trade contractors and shall reckon with all building components and show routing of piping to clear same. Drawings shall be accurately dimensioned to show proposed location of all fire protection system components. Drawings shall be of sufficient detail to allow the creation of a bill of materials for off-site fabrication of at least 90% of the installed system piping. System design shall be completely coordinated with the architectural, structural, mechanical, and electrical features of the building. The drawings shall show all details required by NFPA 13. In all areas with suspended ceilings, reflected ceiling plans shall be prepared showing the location of sprinklers, lights, diffusers, grilles, etc. Drawings shall be

suitable for filing with DOB, FM and FD. Contractor and Contractor's Engineer shall complete these filings with DOB and FM.

D. On some projects the Owner will insist that the Engineer provide CAD files of the Engineering drawings for the Contractor's use. When the Contractor has been provided with the Engineer's CAD files, these files shall not be used to prepare the as-built drawings and drawings similar to the Engineer's contract drawings will not be accepted as as-built drawings.

E. Submit a complete schedule of the material and equipment proposed for this installation to the Architect/Engineer for approval. Include catalog cuts, diagrams, drawings, and such other descriptive data as may be required to clearly show what is intended to be installed and how. In the event any items of material or equipment contained in the schedule fail to comply with the specifications, such items may be rejected.

F. Submit to the engineer five (5) sets of blueprints and hydraulic calculations signed and sealed by a Professional Engineer retained by the contractor. After approval by the engineer, submit three (3) copies of the drawings and hydraulic calculations of the sprinkler system to the regulatory agencies having jurisdiction, including FM Global. Update the drawings to reflect any comments and resubmit the drawings until approval is obtained. Upon receipt of approval submit the drawings and hydraulic calculations to the Architect for record. Approval of the Architect must be obtained before purchasing or installing any equipment. Submissions shall be signed and sealed by an Engineer retained by the fire protection contractor.

G. Approval of submittals will not relieve the Contractor of the responsibility for correcting any errors which may exist or for meeting requirements of the specifications. No partial submittals will be accepted.

H. A set of approved installation drawings shall be kept at the job site and marked to indicate all installation conditions which are different from the approved drawings.

I. In the event that the contractors final design deviates from the bid documents and a re-filing is required, the contractor shall prepare all documents required for the re-filing and provide adequate copies signed and sealed by an engineer retained by the contractor. Contractor shall also execute any documents required to replace Engineer as Engineer of record if Engineer has previously served as Engineer of Record.

J. Grooved joint couplings and fittings shall be shown on shop drawings and product submittals and shall be specifically identified with the applicable manufacturer style or series number.

K. Sprinklers shall be referred to on drawings, submittals and other documentation, by the sprinkler identification (SIN) or Model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

L. Manufacturer's Data: Submit manufacturer's product data for fire protection valves including:

1. Dimensions
2. Sizes
3. End Connections
4. Weights
5. Installation instructions
6. Instructions on repacking and repairing valves.

7. Range of flow for balancing valves and plug valves.

M. Valve Tag List: Refer to Section 22 05 53 of the Specifications.

N. The final project submittal shall be an as-built drawing signed and sealed by the contractor's Engineer. The as-built drawing shall document the final installed condition of the fire protection system and shall meet the as-built filing requirements of the Authority Having Jurisdiction.

1.5 DESIGN REQUIREMENTS

A. Engineer's bid documents are provided to define the scope of the sprinkler work and the general arrangement of systems. It shall be the Contractor's responsibility to install a fully code compliant system in accordance with all applicable codes and any additional requirements that are specified in the Engineer's bid documents. The contractor shall size the sprinkler system pipes in accordance with the requirements of NFPA. Contractor shall submit all calculations to the Engineer for review at time of drawing submittal. Submittal of these calculations to the Engineer will in no way relieve the Contractor of his responsibilities for complete and proper design of the fire protection system. Upon preliminary approval by the Engineer, the Contractor shall prepare a complete set of filing documents for submission to DOB and FM. Filing sets shall be developed in phases as required to allow partial filings and approvals in support of the phasing plan developed for the project. All filings shall include plan drawings suitable for DOB filing and hydraulic calculations as required to support proposed pipe and pump configuration and sizing.

B. The Contractor shall fully inform himself regarding any special characteristics and limitations of the space available for the installation of all materials under Fire Protection Work.

C. The contractor shall ascertain that all his equipment, such as pumps, valves, flow switches and such other apparatus as may be necessary to be reached from time to time for operation and maintenance is made easily accessible for operation and maintenance.

D. Existing conditions revealed during demolition may identify conflicts with the building construction. The contractor shall call the Architects attention to this fact before installing this work and shall be guided by their instructions.

E. The contractor shall prepare calculations in accordance with N.F.P.A., Chapter 13, Insurance Carrier Specifications and requirements herein indicated. Calculations shall be prepared for as many areas of application as necessary to demonstrate to the satisfaction of the Insurance Carrier, Building Department and Architect that the system meets the herein outlined criteria.

F. It shall be the Contractor's responsibility to design the system so that no interferences exist between the fire protection system and work of other trades, equipment and systems designed and installed by others. The latest issues of all architectural, structural, mechanical and electrical drawings shall be reviewed to assist the Contractor in preparing the design so as to avoid interference.

G. This Contractor shall provide all necessary control wiring and equipment necessary for an operational system. This includes, but not limited to, key switches, releasing panels, solenoid valves, etc.

H. Any fees charged by local first responders for false alarms associated with construction activities or installation related conditions will be the responsibility of the Contractor.

I. The Drawings are diagrammatic and indicate the general arrangement and location of equipment, piping, sprinkler heads, etc. Make modifications in the layout work that may be required to suit actual job conditions without extra compensation. Provide all required additional heads and branch piping for a code compliant system, if necessary, whether shown on the Engineer's bid documents or not, at no additional cost to the Owner.

J. Drawings and Specifications are intended to be fully cooperative. Any materials, equipment, or systems related to this Section and exhibited on the Architectural and Fire Protection Drawings but not mentioned in the Specifications are to be executed to the intent and meaning thereof, as if it were both mentioned in the Specifications and set forth on the Drawings.

K. Should any discrepancy or apparent difference occur between Drawings and Specifications or should occur in the work of others affecting the work, the Contractor shall notify the Architect immediately. If the Contractor proceeds with the Work affected without instructions from the Architect, he shall make good any resultant damage or defect. All misunderstandings of Drawings and Specifications shall be clarified by the Architect.

1.6 EXAMINATION AND COORDINATION

A. The Drawings are diagrammatic and indicate the general arrangement of systems and work indicated under this Section. (Do not scale the Drawings). The Contractor shall consult the Architectural Drawings and Details for exact locations of fixtures, and equipment; where same are not definitely located, he shall obtain this information from the Architect.

B. The Contractor shall follow the Drawings in laying out work and check Drawings of other trades to verify spaces in which work will be installed and maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, the Architect shall be notified in writing. The installation shall not proceed before receiving the Architect's written instructions.

C. If directed by the Architect, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades, maintain required headroom and space conditions, and for proper execution of the work.

D. Where variances occur between the Drawings and the Specifications, or within either document itself, the item or arrangement of better quality, greater quantity, or higher cost shall be included in the Contract. Architect will decide on the item and manner in which the Work shall be installed and his decision shall be final.

E. It shall be the responsibility of the Contractor to closely schedule his work so that his work will be installed at the proper time and without delaying the completion of the entire Project.

F. Where the Fire Protection Work will be installed in close proximity to the Work of other trades, or where there is evidence that the Work of the Contractor will interfere with the Work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. The Contractor shall work with all trades to prepare composite working drawings and sections at a suitable scale not less than 3/8" = 1'-0" clearly showing how his work is to be installed in relation to the Work of other trades. If the Contractor installs his Work before coordination with other trades or so as to cause interference with Work of other trades, he shall make necessary changes in his Work to correct the condition without extra charge.

G. Study the Drawings and Specifications in order to insure completeness of the Work required under this Section. Supplementary items normal and necessary to complete the Work, though not definitely shown or specified shall be included.

H. Verify all measurements and conditions in the field before starting work.

I. Examine all surfaces to which Work under this Section is to be applied and notify the Architect in writing if any conditions exist which are detrimental to the proper and expeditious installation of Work. Starting of Work shall be understood to be acceptance of surfaces.

J. If it should be necessary to remove and relocate any material or equipment that has been installed without proper investigation and coordination with the work of other Sections, such materials or equipment shall be removed and relocated without additional cost to the Owner.

1.7 WARRANTIES

A. The entire new system shall be warranted to be free from defects for a period of one (1) year from the date of Notice of Acceptance.

1.8 PROJECT RECORD DOCUMENTS

A. Upon completion of the work, the Contractor shall revise all fire protection drawings to agree with the construction as actually accomplished and stamp “As-Built”. Those drawings where no change is involved shall be likewise stamped. These “As-Built” drawings shall show the fire protection system as it existed at the completion of the contract work.

B. On some projects the Owner will insist that the Engineer provide CAD files of the Engineering drawings for the Contractor’s use. When the Contractor has been provided with the Engineer’s CAD files, these files shall not be used to prepare the as-built drawings and drawings similar to the Engineer’s contract drawings will not be accepted as as-built drawings.

C. See Division 1 for additional requirements.

1.9 CLEANING, PROTECTION AND ADJUSTING

A. The Contractor shall be responsible for the protection of all fire protection systems equipment against breakage or damage at all times until final acceptance of the job

B. All openings left in floor for passage of supply pipes shall be covered and protected. Due precautions shall be taken against freezing during cold weather. All pipes shall be protected with suitable coverings as soon as set. All open ends of pipes shall be closed by a plug fitting to prevent obstruction and damage.

C. The Contractor shall frequently clean up and remove from the Site all rubbish, scrap materials and debris caused by his Work, and upon completion of the Work and before final payment is made, he shall remove from the site all surplus material, temporary structures, tools and all debris resulting from his operation.

1.10 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions of the Contract and Supplementary General Conditions and Division 1 - General Requirements, apply to work of this Section. This Contractor shall comply with all applicable sections of Divisions 21 through 23.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Pipe joints above ground shall be screwed, flanged, welded, or mechanical couplings. Welded joints are not acceptable in pipe less than 2" in diameter. No welding permitted except with certified welders in shop. No field welding of sprinkler pipe will be permitted. No field made weld-o-lets are permitted.

B. Above ground piping shall be roll grooved Schedule 40 black steel pipe. Schedule 10 (Thin wall) piping is not permitted.

C. Below grade piping shall be ductile iron pressure pipe, tar coated, cement lined, ANSI A21.51, Class 50 with ANSI 21.10 fittings and ANSI 21.11 rubber gaskets.

D. Screwed fittings above ground shall be gray cast iron suitable for 175 psi cold water working pressure and so rated. Provide valves with an elevated pressure rating for work in buildings more than 350 feet tall.

E. Sprinkler piping and fittings for dry pipe systems shall be galvanized, schedule 40 minimum. All fittings on galvanized piping shall be galvanized in accordance with ASTM A153.

F. Mechanical fittings shall be as follows:

1. Grooved end fittings shall be UL/FM approved, full flow, short radius ductile iron conforming to ASTM A536, or carbon steel conforming to ASTM A53 with factory grooved ends designed to accept mechanical couplings.

2. Grooved mechanical couplings shall be UL/FM approved, consisting of two ASTM A536 ductile iron housings, a pressure-responsive, synthetic rubber gasket, and plated steel bolts and nuts.

a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9

1) 1-1/4" through 4": "Installation Ready" stab-on design, for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. Victaulic FireLock EZ Style 009.
2) 5" and larger: Standard rigid couplings. Victaulic FireLock Style 005 or Style 07 Zero-Flex.

b. Flexible Type: Use in seismic areas where required by NFPA 13.

1) 2” through 8”: “Installation Ready” stab-on design, for direct ‘stab’ installation onto grooved end pipe without prior field disassembly and no loose parts. Victaulic Style 177 QuickVic.
2) 10” and larger: Standard flexible couplings. Victaulic Style 77.

3. Coupling gaskets shall be listed for use as follows:

Fire Protection Service	Temperature Range	Gasket Recommendation
Water/Wet Systems	Ambient	C-Shape, Grade EPDM, Type A

4. Flange adapters shall be ASTM A536 ductile iron, flat faced, designed for incorporating flanges with ANSI Class 125 or 150 bolt-hole patterns to a grooved piping system. Victaulic Style 741 or 744.

G. All sprinkler pipe threading shall be completed with fixed diameter threading dies.

2.2 BUTTERFLY VALVES

A. Butterfly valves shall be furnished with slow closing worm gear type indicating operator. Valves shall have a completely sealed shaft, integral flange seals and hex drive. Valves shall be rated for 175 psi maximum pressure rating.

B. Grooved end butterfly valves shall be furnished with a weather-proof actuator with pre-wired supervisory switches. Ductile iron body, nickel-plated ductile iron disc, Type 416 stainless steel two-piece stem and Nitrile seat, up to 365 psi CWP rating.

1. Supervised in the open position: Victaulic Series 765 or Series 705
2. Supervised in the closed position for fire pump metering test lines and rooftop test units: Victaulic Series 766 or Series 707C

2.3 O.S.&Y. VALVES

A. Outside stem and yoke gate valves shall be of the wedge disc type and shall permit straight line flow and complete shut-off. Valves shall be designed to allow packing under full pressure when wide open. Valves shall have bronze mounted, resilient wedge type, grooved ends or grooved by flanged ends, ductile iron body, cast iron bonnet and disc with EPDM disc coating, and brass stem. Valve shall be rated for 250 psi maximum pressure rating. Victaulic FireLock Series 771 or Kennedy Model 7092.

B. Provide valves with an elevated pressure rating for work in buildings more than 350 feet tall.

2.4 CHECK VALVES

A. All swing check valves shall be 175 psi non-shock cold water service, iron body, bronzed trim, horizontal swing with renewable bronze seat and rings. All check valves two (2) inches and smaller shall be bronze, screwed, horizontal swing type. All check valves two and one half (2½) inches and larger shall be flanged or grooved type. Provide automatic ball drip where valve is subject to freezing. All check valves shall include removable face plate

B. All water check valves shall be 175 psi working pressure, iron body with spring actuated double bronze plate and rubber seat with UL Listing and FM approval.

C. Provide valves with an elevated pressure rating for work in buildings more than 350 feet tall.

D. Grooved end check valves shall have a pressure rating up to 365 psi CWP, ductile iron body, stainless steel or EPDM coated ductile iron disc, stainless steel spring, nickel-plated or welded-in nickel seat.

1. 2” through 3”: Victaulic FireLock Series 717H and 717HR (365 psi CWP).
2. 4” through 12”: Victaulic FireLock Series 717 and 717R (300 psi CWP).
3. 2-1/2” through 8”: Viking G-1 (300 psi CWP)

2.5 GLOBE AND ANGLE VALVES

A. Valves shall be furnished with renewable disc, non-shock, and shall back seat in the fully opened position to allow repacking under full pressure without removing the valve from the line. Valve shall be rated for 175 psi working pressure.

B. Provide valves with an elevated pressure rating for work in buildings more than 350 feet tall.

2.6 PRESSURE REDUCING VALVES

A. Provide pressure reducing valves on all systems served by storage tanks and at any location where branch piping or sprinkler heads would otherwise be exposed to a pressure above 150 psi.

B. Approved manufacturers are Reliable, model PRV or approved equal.

2.7 VALVE SUPERVISORY SWITCHES

A. All valves which control water to automatic sprinkler heads shall be equipped with supervisory switches having one normally open contact and one normally closed contact.

B. Provide tamper switches on all valves in the fire line.

C. Switch shall be approved for use on the type of valve to be monitored.

D. Approved manufacturers are Potter Electric, System Sensor, or equal.

2.8 FLOW SWITCHES

A. All flow switches shall be field adjustable vane type with pneumatic retard and 175 psi working pressure. Units shall be suitable for installation by drilling pipe and securing with U-bolt furnished with the switch.

B. All zone flow switches shall be Global Vision Inc. Zone Check assemblies.

1. Assembly shall include vane type waterflow detector factory installed on assembly. Waterflow switches shall be adjusted so that the device will transmit a waterflow alarm within 30 seconds of opening the inspector’s test valve on the sprinkler system. Units shall be single pole double throw, suitable for 24 volt D.C. service with one normally open contact and one normally closed contact.

2. Assembly shall include circulation pump for inspection of flow switch without discharge of water from the system. Pump shall be 120V, single phase, 60 hz, 185 W maximum. Pump shall be factory installed on assembly with inlet/outlet valve.
3. Assembly shall be provided with key-switch for testing of flow switch. Key-switch shall include local LED signals for test initiation and flow switch activation.

2.9 AUTOMATIC FIRE SPRINKLER HEADS

A. Sprinkler heads shall have a temperature rating of 165ºF except for heads in areas of high temperature and in close proximity to heat sources which shall be temperature rated in accordance with NFPA 13.

B. Sprinkler heads in ceilings to be concealed pendant.

C. Supply Owner an extra stock of six sprinklers minimum, three of each type, and any special required sprinkler wrench. Heads shall be packed in a suitable container for wall mounting. Provide additional heads that may be required by NFPA 13.

D. Sprinkler heads shall be Underwriters' Laboratories approved cast brass quick response wet type with 1/2" discharge orifice where scheduled as K-Factor 5.6 and 17/32” discharge orifice where scheduled as K-Factor 8.0. Sprinkler heads with reduced orifice shall be provided where approved by code and required to address a limited water supply condition.

E. Any and all sprinkler heads placed in location where they are liable to be accidentally hit in the normal course of building occupancy shall be provided with heavy wire guards. Guards shall be listed, supplied, and approved for use with the sprinkler, by the sprinkler manufacturer. Locations include, but are not limited to, above cable trays, within mechanical or storage rooms below 8 feet, and loading docks.

F. In the instance where sprinkler escutcheon are used (horizontal sidewalls & pendent), the escutcheon shall be UL Listed with the specific sprinkler head.

G. The sprinkler heads in all areas are to be installed on a true axis line in both directions with a tolerance of ±1/2". At the completion of the installation, if any heads are found to exceed the above shall be corrected and any adjoining work that may be disturbed in reinstalling heads shall be repaired or replaced at no additional cost to the Owner. All heads installed in hung ceilings shall be located on the centerlines of tiles.

H. Sprinkler heads shall be as follows. Substitution of equivalent products from approved manufacturers permitted:

Area	Head	Reliable Model #	Victaulic Model #	Tyco Model #
Finished spaces and corridors	Fully recessed, concealed type. Off white painted cover.	G5	V3801	RFII
Unfinished spaces and corridors	Standard upright/sidewall head, brass finish	F1FR	V3404	TY-FRL

Mechanical Rooms, storage, room without finished ceilings	Standard upright/sidewall head, brass finish with wire guard.	F1FR	V3404	TY-FRL

2.10 INSPECTOR'S TEST AND DRAIN CONNECTION ASSEMBLY

A. Victaulic Co. No. 720 TestMaster II or approved equal.

2.11 ALARM FACILITIES

A. Equipment necessary to accomplish a transmitted waterflow signal and auxiliary contacts shall be provided. Main shut-off valves shall be electrically supervised. Any tamper-proof switches required for testing the sprinkler system shall be furnished. Alarm devices shall be as manufactured by Potter Electric Signal Company or approved equal. Provide all devices required for proper transmission of all alarms to main fire alarm control panel. Wiring shall be provided in Division 26.

2.12 INSPECTOR TEST CONNECTIONS AND DRAINS

A. Furnish and install Inspector Test Connections and drains, piped to suitable plumbing drains, to allow for testing and maintenance of all parts of the system. Provide additional supplemental drains at all system low points.

2.13 MISCELLANEOUS

A. Nameplate data information: The nameplates shall be installed on each main riser and shall include the following design data: building designation, location of remote area, design density, area of application, and system demand (GPM and PSIG at base of riser).

B. Control valve signs: The Contractor shall provide a description sign, minimum dimensions seven (7) inches by nine (9) inches, for every valve in the system which controls water to sprinkler heads. Signs shall be single faced, white letters on a red background, with a space designating who to notify if valve needs to be closed. Signs shall be fastened to each valve with lightweight chain.

C. Miscellaneous signs: Signs for alarm test valves, main drains, auxiliary drains, etc. shall have minimum dimensions of two (2) inches by six (6) inches. Signs shall be single faced, white letters on a red background. Each sign shall be fastened to each valve with lightweight chain.

D. Provide (2) 11 x 17 copies of approved system diagram. One shall be mounted in a glazed frame as directed by Architect, the second shall be provided to the Owner for file.

E. Provide a sign at the base of each riser describing the design criteria of the system.

2.14 PIPE HANGERS

A. Provide products which are Underwriters Laboratories listed.

B. Provide pipe hangers and supports of which materials, design, and manufacture comply with ANSI/MSS SP-58, MSS SP-69, MSS SP-89.

C. Assume the responsibility for the proper transfer of the loads of the piping system to the structure. No additional cost to the Owner should be expected for any corrective work during construction. All pipe supports shall be of type and arrangements as hereinafter specified and shall be so arranged as to prevent excessive deflection and avoid excessive bending stresses between supports. All auxiliary steel for pipe supports shall be furnished and installed by this Contractor, where overhead construction does not permit fastening of hanger rods in required locations.

D. Supports and hangers shall be provided for all horizontal and vertical piping. The hanger design shall conform to the ASA Code for Pressure Piping.

E. All bracket clamps and rod sizes indicated in these Specifications are minimum size only. This Contractor shall be responsible for structural integrity of all supports. All structural hanging material shall be selected for a factor of safety of five (5).

F. Pipe supports shall be of the following type and figure number as manufactured by Anvil.

Pipe Hanger Schedule:

Item	Anvil Fig. #	Piping Sizes
Beam Clamp	92	All
Beam Clamp w/Retaining Clip	87	All
Clevis Hanger	260	8" and Smaller
Pipe Saddle	264	4" and Larger
	192	2, 2-1/2", 3"
Riser Clamp	261	All
Stand Off Pipe Clamp	103	All
Brackets	195, 199	All
Steel Washer Plates	60	All
Concrete Insert	CB 282	All

G. Pipe Supports in Pipe Chases: Supports shall securely hold piping prevent vibration, etc. Provide supplemental pipe supports and channels as required.

H. In grooved piping systems, Victaulic Style 009, 005, and 07 rigid couplings may be used with IPS steel piping systems, which meet the support and hanging requirements of NFPA 13. An adequate number of Victaulic Style 177, 75 and 77 flexible couplings shall also be used to compensate for thermal expansion/contraction of the pipe.

2.15 PRESSURE GAUGES

A. Pressure gauges shall be rated for 150% of working pressure.

B. Gauges shall be FM approved and UL listed.

C. Provide pressure gauges where shown on details, as well as at the top of existing and new standpipe risers.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

A. The Contractor shall investigate the conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing his work at the building. Materials shall not be fabricated or delivered to the site before the approved shop drawings and equipment submittals have been received by the Contractor.

B. Entire installation shall be in accordance with approved shop drawings. When unforeseen job site conditions will not permit piping to be installed as shown on the drawings, necessary changes will be made to accomplish a coordinated system without additional cost to the Owner, even though pipe may have been delivered to the site cut to pre-determined lengths.

C. Provide gate valves of size and at locations shown on the drawings and any additional valves required by local authorities. Locate all valves where readily accessible. Provide chain wheel operators or permanent ladders for all valves not accessible from the floor. All main line valves shall be electrically monitored and secured with a chain and padlock which will lock the valve in an open position.

D. Provide check valves of size and at location shown on the drawings and any additional check valves that might be required by local authorities.

E. Provide valved test drains as required by NFPA. Pipe test drains to spill to nearest floor drain, or receptor. Make provisions to drain all parts of the piping system for service including additional drains at all system low points.

F. Hydraulic calculations shall be performed in accordance with the requirements of NFPA 13 and 14. The Contractor shall calculate the demand point for the system so that it remains ten (10) percent below the final water supply curve at the connection to the public water system. The demand point for the systems shall include an allowance for the inside and outside hose demand. The basis for the hydraulic calculations shall be determined by a waterflow test performed by the Contractor and acceptable to the Authority Having Jurisdiction.

G. Be responsible for trenching, bedding material, removal of waste material, paving removal and replacement, barricades, and any materials necessary for vehicle and person access across work areas.

H. Bedding shall be well graded non-expansive, non-organic soil containing no rocks over one (1) inch in diameter. There shall be no refuse or corrosive materials in this soil.

I. All bedding and backfill shall be laid and compacted in accordance with excavation and backfill requirements described elsewhere in the specification.

3.2 PIPING INSTALLATION

A. Perform the work in a professional workmanlike manner, according to the best practices of the trade. All sprinkler piping must be substantially supported from the building structure and only approved type hangers shall be used. Sprinkler piping in all areas shall be concealed unless otherwise noted on the contract drawings. In those noted locations and in areas with no ceiling, piping shall be installed as high as possible using necessary fittings and auxiliary drains to maintain maximum height. Any deviations found necessary shall be immediately brought to the attention of the Architect. All piping discharging outside (main drains, Inspectors Test Connections, etc) shall do so on paved surfaces or splash blocks.

B. All inside piping shall be joined by means of screwed, flanged, flexible gasketed joints, or other approved method. Risers, feed mains, cross mains, and branch lines may be shop welded using approved welding fittings and conforming to the standards as set forth in the latest edition of NFPA 13. Welding and torch cutting shall not be permitted as a means of installing or repairing sprinkler system piping on-site.

C. Provide escutcheons on penetrations of interior walls. Chrome or white -plated escutcheons shall be provided where exposed piping passes through finished floors, walls, partitions, and ceilings. Secure plates to pipe with set screws or spring clips. Color is subject to architect/owners approval. All escutcheons for sprinkler heads must be UL Listed with the specific sprinkler head.

D. It is the intent that each part of the Fire Protection Systems shall be complete in all details and all lines provided with all control valves as indicated on Drawings, or as may be required for the proper control of the pipe lines under this Section so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the building, including every 100 ft of standpipe.

E. Run piping straight and as direct as possible. In general, form right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

F. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

G. No piping or work shall be concealed or insulated until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

H. Where complete concealment is impossible because of obstructions such as beams, ducts, lights, piping, etc., the Contractor shall not install any work before first consulting with the Architect and his instructions (written or revised Drawings) shall be followed.

I. Piping shall be supported from structural steel only, piping shall not be hung from other piping, ducts, conduits, metal deck or from equipment of other trades. Provide necessary structural

members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.

J. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction.

K. The Architect must approve method of supporting pipes from building structure before work is started. The Contractor shall bear all responsibility for materials and workmanship as described in this Section, and shall make sure that all hangers and supports are properly and permanently connected to building structure.

L. Pipe hangers shall be of the clevis type with threaded rod support. Chains, straps perforated iron or wire hangers are not permitted.

M. Where piping is run near the floor and not hung from the ceiling construction but is supported from the floor, such supports shall be of pipe standards with base flange and adjustable top yoke similar to Anvil Fig. 264 or equal.

N. All piping running on walls shall be supported by means of hanger suspended from heavy angle iron wall brackets. No wall hooks will be permitted.

O. Lateral bracing of horizontal pipe shall be provided where required to prevent side sway or vibration. The lateral bracing shall be of a type approved by the Architect and shall be installed where directed by the Architect. All piping shall be seismically restrained in accordance with NFPA 13.

P. All anchors shall be separate and independent of all hangers, guides and supports. Anchors shall be of heavy blacksmith construction suitable in every way for the work approved by the Architect. Anchors shall be welded to the pipe and fastened to the structure with anchor type bolts.

Q. All fire protection piping shall not be in contact with any other system. Fire Protection contractor shall work with all other trades to avoid having their trades in contact with any other system.

R. All horizontal steel pipe shall be supported at maximum intervals as follows: Steel pipe - up to 1-1/2" - 12'-0"; 1-1/2" and larger 15'-0". In no case shall a pipe extend more than 12" past a hanger without additional support.

S. Trapeze type hangers shall be made up of angles bolted back-to-back or channels for supporting parallel lines of piping. Trapeze type hangers shall be supported with suspension rods having double nuts, and securely attached to construction with inserts, beam clamps, steel fishplates, cantilever brackets, lag screws or other approved means. Kindorf or other materials typically used for the support of electrical equipment or conduit are not acceptable. Piping supported by trapeze hangers shall be provided with hold down clamps at the trapeze hangers.

T. Maximum weights on hanger rods shall be such that stress in tension shall not exceed 9,000 psi, using root area of threaded portion. In no case shall hanger sizes be less than 3/8" for pipe up to 4", 1/2" for pipe 5", 6" and 8".

U. Supports for vertical piping shall be double bolt riser clamps, with each end having equal bearing on the building structure located at alternate floors but it shall be no more than 25 feet between supports.

V. All hangers, rods, inserts, clamps, stanchions, brackets, etc., shall be dipped in zinc chromate primer before installation and provided with one (1) coat of approved type paint after installation.

W. All pipe supports shall be installed to avoid interference with other piping, hangers, electrical conduits and supports, building structures and equipment.

X. A Victaulic factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products.

Y. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

Z. Painting: Paint all exposed piping. All exposed piping in finished areas shall be painted Red in accordance with building code. All bulk main piping 3 inch and larger shall be identified “SPRINKLER-WATER”.

AA. Piping shall be pitched to drain to inspector test connection or drum drip. Branch piping in dry systems shall be pitched at 1/2” per 10’, mains shall be pitched at ¼” per 10’.

BB. Flushing valves shall be provided on the mains, cross-mains, branch lines and run outs of new sprinklers systems, to facilitate post-construction cleaning and flushing of the system. Valves shall be sized per NFPA 25, in order to obtain the NFPA required minimum velocity of 10ft/s for any given pipe size.

On piping 2” and smaller, line size ball valves can be applied. In mains larger than 2”, typically there is a need for multiple 2” ball valves (especially on 4” and larger mains) to achieve the required flow. The engineer shall use hydraulic calculations to determine the number of 2” valves required on mains larger than 2”.

CC. Global Vision Inc. Zone Check flow switch assemblies (with a key-operated wall switch) are required for all zones. This device allows the annual inspections to be performed without the discharge of system water to drain. Said assemblies shall be exposed and at an elevation (approx. 7’ above finished floor) that allows easy access for maintenance. The key-operated switch shall be installed 48” above finished floor.

DD. Manual inspector’s test and drain valves are also required for zones where Zone Checks are installed.

EE. Threaded fittings are preferred for exposed systems in aesthetically sensitive areas. The use of plain end fittings is discouraged.

FF. All fire service mains shall be controlled by a PIV (post indicator valve) at the building service entrance. All PIVs shall be lockable and supervised by the fire alarm control panel. When selecting the proper location and finish, care should be taken to maintain visibility and 3' of clearance around the PIV for proper operation.

3.3 VALVE INSTALLATION

A. Comply with the following requirements:

1. Install valves except butterfly with stems pointing up, and as close to vertical as possible. Butterfly valves to be offset at least 10° from vertical.
2. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves so as to be accessible and coordinate location with other trades, walls, etc.
3. Provide drain valves at main shut-off valves, low points of piping and apparatus.
4. Provide separate support where necessary.
5. Furnish all valves as indicated on the plans, or as may be required for the proper control of the pipe lines installed under this Specification. All water valves shall have a minimum working pressure of 175 psi, water rated unless otherwise noted on the Drawings or specified herein. All valves shall be of one manufacturer.
6. All gate valves within the building shall be wedge gate valves with painted iron wheel handles, shall have gland followers in stuffing boxes, and shall be constructed that they may be repacked while open and under pressure. All valves shall have the name of the manufacturer and working pressure cast or stamped thereon.
7. All gate valves 3" and smaller shall be all bronze with brazed or screwed joint ends as required by the piping system in which they are installed.
8. All gate valves 4" and larger shall have iron bodies with bronze mounting except where otherwise required by the authorities having jurisdiction and shall be provided with screwed or flanged ends as required by the piping system in which they are installed. All gate valves controlling equipment shall be of the OS&Y rising stem type except where space conditions do not permit the installation of this type of valve. In such cases non-rising stem valves with indicators shall be provided. \
9. Globe valves shall be of all bronze with composition disc, threaded or brazed joint ends as required by piping system in which they are installed.
10. Drain valves shall be 3/4" heavy cast brass with composition washers with male thread for hose connections.
11. All valves on the exterior fire protection water piping shall comply with Local Fire Department and Water Company requirements.
12. All valves shall have the trademark of the manufacturer and the guaranteed working pressure cast or stamped on the body of the valve. All gates or globes, etc., shall be of one manufacturer and working pressure cast or stamped thereon.
13. All valves used on the fire standpipe and sprinkler systems water service, shall be approved by the Underwriters' Laboratories, Factory Mutual and all the other authorities having jurisdiction. Valves shall be iron body bronze mounted OS&Y solid wedge type valves with rising stems for 175 psi minimum working pressures; iron wheel handles shall be painted red.
14. Tamper switch shall be provided on all fire standpipe and sprinkler valves.

15. The exterior valves shall conform to all applicable requirements of American Water Works Association C500-61 Standard for Gate Valves for Fire Water Work Service.
16. The entire fire protection system shall be supplied with valves so located, arranged and operated as to give a complete regulating control to all fixtures and apparatus
17. Valves, where exposed and used in connection with finished piping, shall be same finish as the pipe.
18. Do not install bronze valves and valve components in direct contact with steel unless bronze and steel are separated by dielectric insulator.
19. Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.
20. Select and install valves with renewable seats, except where otherwise indicated.

B. Provide chain wheel operators or ladders for valves more than 7’ – 0” AFF in mechanical rooms and wherever shown on drawings.

3.4 CHECK VALVES

A. Check valves up to and including 3" shall be all bronze swing check type with threaded or brazed joint ends. Check valves 4" and larger shall be iron body bronze mounting and shall be provided with screwed or flanged joint ends as required by piping system in which they are installed.

B. Swing Check Valves shall be installed only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards. Do not install in pump discharge piping.

C. Silent Check Valves shall be installed in all pump discharge lines. Silent check valves may be installed in vertical pipes with flow down upon Engineer’s review for each instance.

D. Wafer Check Valves shall be installed between 2 flanges in horizontal or vertical position.

E. Horizontal Lift Check Valves shall be installed in horizontal piping line with stem vertically upward.

F. Vertical Lift Check Valves shall be installed in vertical piping line with upward flow with stem vertically upward.

G. Spring Loaded Horizontal Lift Check Valves shall be installed in horizontal piping line with stem vertically upward.

3.5 AUTOMATIC FIRE SPRINKLER HEAD INSTALLATION

A. All sprinkler heads shall be in alignment, and parallel to ceiling features, walls, etc. The Contractor shall provide one (1) spare sprinkler cabinet complete with sprinkler wrench and 12 sprinklers of assorted temperature ratings of the type necessary and in use throughout each system at each main riser.

B. Conform to spacing and dimensional constraints indicated by the Architect on the reflected ceiling plans. Sprinkler heads shall be centered within ceiling grid. Where no ceiling grid is provided the heads shall be aligned with any fire alarm device or light fixture in the vicinity. Where the contractor’s failure to install sprinkler heads in proper alignment requires the removal, replacement or alteration of ceilings to correct the errors the Sprinkler Contractor shall be responsible for the cutting, patching and restoration of finishes as necessary.

C. The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.

D. Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install sprinklers with cracked bulbs.

3.6 FIRE STOPS AND PENETRATION SEALS

A. All new piping penetrations through fire rated floors and walls shall be sealed with fire resistant sealant to prevent the spread of smoke, fire, toxic gas, and water through the penetration either before, during or after a fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed.

B. See additional requirements elsewhere in this specification.

3.7 PRESSURE GAUGE INSTALLATION

A. Install pressure gauges at the following locations: street side of check valve; at system side of all control valves. Each gauge connection shall not be less than ¼” and shall be equipped with a shut-off valve and provision for draining.

B. The required pressure gauges shall be 3” diameter minimum and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal, and shall be located where they will not be subject to freezing.

3.8 TAMPER SWITCH INSTALLATION

A. Install tamper switches on all control valves.

3.9 FLOW SWITCH INSTALLATION

A. Install flow switches to properly confirm flow in all system zones.

3.10 FIRE ALARM WIRING

A. All fire alarm and monitor wiring shall be done under the Electrical Division but the proper operation of signaling devices will be the fire protection Contractor’s responsibility.

3.11 FLOOR CONTROL VALVE INSTALLATION

A. Floor control valve shall be a complete assembly consisting of an OS&Y valve, grooved butterfly pressure reducing valve (if required), vane type flow switch with retard, inspector’s test and main drain valves.

B. Pipe discharge from inspector’s test and main drain valves through sight glass and orifice to a drain riser or floor drain.

C. This contractor shall install drain risers to serve floor control valves.

3.12 PIPE TESTING

A. The entire fire protection piping system shall be tested hydrostatically at not less than 200 psi pressure for two hours, or at 50 psi in excess of the maximum static pressure when the maximum static of pressure is in excess of 150lbs. The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested. Each complete system (all associated piping and alarms), shall be tested and accepted as a complete unit, with data recorded on an approved “Contractor’s Material and Test Certificate”. System pressure tests shall be against a blank test flange and not against a valve seat.

B. All tests shall be conducted in the presence of the Architect and Owner. Any system failing to meet the specified test requirements shall be repaired and retested at no additional cost, until the test requirements are met.

3.13 MAINTENANCE AND OPERATIONAL INSTRUCTIONS

A. System description, system theory of operation, and system final inspection and acceptance documents of the completed system (as built) shall be submitted in a bound book as described in Division 1. The maintenance manuals and instructions shall include a brief description of the type of system installed, routine-type maintenance work defined by step-by-step instructions that should be performed to ensure long life and proper operation, and the recommended frequency of performance. The instructions shall also include possible trouble spots with diagnosis and correction of each. The theory of operation brochures shall describe the function of each component or subassembly in block-diagram type presentation to a degree that a craftsman will understand the system well enough to operate and maintain it.

3.14 PROTECTION

A. Protect all apparatus, fixtures, materials, equipment, and installations so as to prevent damage as a result of new work. The Contractor shall replace at his own expense any item, which is marred, defaced, broken, or damaged in any way, prior to the date of Notice of Acceptance.

3.15 PAINTING

A. Contractor shall paint all exposed new and existing fire protection systems to allow for rapid identification by fire department at all times. New work shall be painted at time of installation; existing systems shall be painted immediately upon exposure to view. Contractor shall continuously update system painting to remain current and accurate at all times. All systems removed from service shall be suitable marked.

3.16 LABELING

A. All piping, valves, devices, etc., shall be labeled in accordance with the requirements of the code, referenced standards, local laws and fire department directives.

3.17 FIELD QUALITY CONTROL

A. All fire protection systems shall be thoroughly cleaned and flushed with tri-sodium phosphate or a cleaning agent approved by Facilities Engineering prior to final acceptance. Once the system is filled by the Contractor, a sample will be taken to verify the concentration of the cleaning agent within the system.

B. Clean dirt and debris from sprinklers.

C. Remove and replace all sprinklers having any paint on them that is other than the factory finish.

D. Pipe System Cleaning:

1. Clean all pipe lines or sections of lines and connected equipment in new or modified systems and/or flush free of all pipe line debris loosened or introduced as a result of this Contract. This shall include removing all debris that has settled or collected at low points, in equipment, etc. Test equipment used for piping tests may be used to circulate cleaning liquids.
2. Clean and disinfect sprinkler distribution piping as follows:

    a. Purge new and reused distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
    b. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
    c. Fill system with water/tri-sodium phosphate (TSP) solution containing at least 1 gallon TSP liquid per 1000 gallon of system volume, isolate and allow to stand for 24 hours.
    d. Drain system of previous solution to sanitary sewer.
    e. Flush system with clean, potable water until no TSP remains in water coming from system.
    f. Submit water samples in sterile bottles to authorities having jurisdiction.
    g. Prepare reports of purging activities.

E. Each system will have a corrosion coupon and test port rack (1" stub with valve and cap) installed at the alarm valve. The corrosion coupons shall be obtained from the FM Pipe Shop Water Treatment Lab so the water quality and corrosion data can be properly recorded and monitored over time as part of ongoing routine maintenance.

F. New sprinkler systems shall not be treated for MIC upon completion of final system cleaning.

END OF SECTION 211300

SECTION 219000 - FIRE SUPPRESSION SYSTEM PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Test and balance reports
5. Record drawings
6. Permit requirements
7. Valve tag list

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the fire protection systems.

B. Within 30 days of the first major milestone submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary – Fire Protection

- ☐ All required submittals have been submitted and either been approved or modified in accordance with the Engineer’s “make corrections noted” comments.
- ☐ All equipment has been started up and is functioning within manufacturers’ recommendations without any undue noise or vibration. (Submit a list of equipment with startup dates. Provide list at a point 65% into construction schedule).
- ☐ Access doors have been installed as required for concealed equipment, valves, etc.
- ☐ All equipment has been installed with the manufacturers recommended and code required service clearances and is fully accessible for required maintenance.
- ☐ All equipment and piping is labeled per specifications.
- ☐ All action items are complete as listed in the action items reports. Submit a list of action items with sign off by Architect or Engineer for record. Punch list to be completed prior to turn over of building.
- ☐ Fire sprinkler system tested per specifications.
- ☐ Operation and maintenance manuals submitted with table of contents and required documentation for extended warranties.
- ☐ Factory Testing documented and submitted for record.
- ☐ Record drawings submitted to Engineer and Architect per specifications.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 TESTING AND ADJUSTMENT FOR FIRE PROTECTION WORK

A. All tests shall be made in the presence of the Architect or their representatives, and the local authorities having jurisdiction of the work to be tested, as may be directed; and at least 72 hours notice shall be given in advance of all tests. Contractor shall perform equivalent test prior to scheduling supervised test.

B. The Work of this Contractor shall include the furnishing of all testing instruments, gauges, pumps, smoke machines, and other equipment required or necessary for tests, required by laws, rules and regulations and as specified.

C. Provide all other tests required by local inspectors and all other authorities having jurisdiction.

D. All appurtenances shall be operated after installation to determine whether or not they meet the requirements of the Specifications.

E. All defects disclosed in the work be tests and otherwise shall be made good or the Work replaced without additional cost to the Owner. No caulking on screwed joints, cracks or holes will be acceptable.

F. Tests shall be repeated after any defects disclosed thereby have been made good or the work replaced if it is deemed necessary.

G. All tests shall be made at the expense of the Contractor.

H. Tests are not permitted to be made with air except as noted.

I. Contractor to provide required test plug tee fittings during erection of pipe system.

J. If the pipe installation fails to meet testing requirements, the Contractor shall determine at his own expense the source or sources of leakage, and he shall repair or replace all defective materials or workmanship. The completed pipe installation shall meet the requirements of the tests after the leaks have been corrected.

K. All piping which is to be enclosed in partitions or hung ceilings shall be tested and made tight when directed by the Construction Supervisor and in adequate time to permit the installation of partitions and ceilings. When necessary, the Contractor shall drain the piping and/or take precautions as required to prevent damage by freezing.

L. The Contractor shall also be responsible for the Work of other trades that may be damaged or disturbed by the tests, or the repair or replacement of his Work, and he shall, without extra charges, restore to its original condition any Work so damaged or disturbed.

M. Before any paint is applied, the fire standpipe system shall be tested hydrostatically at not less than 200 psi pressure for two (2) hours minimum, and in accordance with all requirements of the authorities having jurisdiction and NFPA latest edition.

N. Any fees charged by the Fire Department for false alarms attributed to the construction of the fire suppression system will be the responsibility of the Contractor until such defects are corrected and false alarms due to system installation no longer occur.

3.3 LIFE SAFETY SYSTEMS

A. The contractor shall provide a detailed test procedure, with instrumentation to be used, for approval by the engineer and building official prior to any testing.

B. All life safety systems shall be fully and successfully tested by the contractor before being witnessed by the engineer or building official Once tested by the contractor and fully operational, the systems shall be demonstrated to the engineer. Once accepted by the engineer the system shall be demonstrated to the building and fire officials.

3.4 COORDINATION WITH OTHERS

A. The Division 21 through 23 contractor shall coordinate his requirements with the General Contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 21 through 23 systems.

3.5 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION 219000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 05 01 – Mechanical and Electrical Coordination
Section 23 05 02 – Basic Mechanical Requirements
Section 23 05 03 – Basic Mechanical Material and Methods

1.2 DESCRIPTION OF WORK

A. Except as otherwise specified under "Related work Not Included", the work of this Contract consists of furnishing all labor, materials, equipment and appliances necessary and required to completely do all Plumbing Work as indicated on the Drawings or described or referred to in the Specifications, including, but not limited to the following:

1. Interior alteration work, removals, replacements, relocations, etc. to the existing plumbing and fire protection systems in all renovated areas as indicated on the Drawings.
2. Complete interior storm water drainage systems with leaders, roof and area drains, and piping system conveying storm water drainage to existing storm drainage system.
3. Complete interior sanitary, soil, waste and vent piping systems, including all required connections to all plumbing fixtures and equipment, house sewer, and connections to the existing interior piping or to the site sanitary sewer system.

   Note: Where existing soil and waste capped or plugged outlets are found to be inaccessible or where the elevation cannot be met, the Contractor shall have an option to cut into the existing stack or to run the new piping down to the next floor and connect to an existing outlet. The Contractor shall include this optional work in the base bid scope of work.

4. Complete interior domestic cold water system including connections to the water system piping and/or existing interior piping systems, and connection to all fixtures and equipment requiring cold water.

   Note: Add water meter and strainer with remote readout.

5. Complete interior domestic hot water distribution systems including connections to all fixtures and equipment requiring hot water, connections to existing hot water supply and hot water circulation systems.

   Note: Specify water meter for fire service complete with cross connection control devices.

6. Disconnecting all fixtures and equipment to be removed, even if the fixture or equipment is to be removed and under another Division or Section of these Specifications.
7. Plumbing fixtures and trim for same.
8. Furnishing of access doors for installation under another Division or Section of these Specifications.
9. Make all plumbing connections required for equipment furnished under other Divisions or Sections of these Specifications.
10. Hose bibbs, shock absorbers, vacuum breakers and backflow preventers.

11. Sleeves, hanger and supports.
12. Insulation for piping and equipment.
13. Apply for and obtain and pay for all permits, certificates, inspections and approvals required in connection with all Plumbing Work.
14. Shop drawings, samples and instructional manuals, tests and adjustments.
15. Installation of all fixtures furnished by Owner and/or furnished under other Divisions or Sections of the Specifications.
16. Provide roughing (water supplies, soil, waste, and vent piping) for all fixtures and equipment furnished and/or installed under other Divisions or Sections of these Specifications.
17. All interlocking control wiring and conduit.
18. Color coding and stenciling of all piping systems.
19. Cutting and rough patching.
20. Cap flashing and prime painting.
21. Tests for all systems provided under this Section.
22. Where due to Union regulations or trade agreements, any of the work shown on the Drawings or specified herein is not considered Plumber's Work, this Contractor shall subcontract the work in question, but this Contractor shall be held responsible for the complete installation.
23. It is not the intention of these Specifications to describe nor the Contract Drawings to show in detail, all the various pieces of apparatus and appurtenances and their connections. This Contractor shall, as part of the Contract, furnish and install all incidentals, such as pipe, fittings, valves, etc., required to complete the installation of the equipment. This Contractor shall refer to Architectural Drawings and Plumbing Drawings for exact location of fixtures including type and quantities. This Contractor shall be responsible for providing isolation valves in locations suitable to isolate equipment, risers, building sections, etc. This Contractor shall be responsible for providing and connecting all fixtures and equipment.
24. All work described in the Specifications and not shown on the Drawings, or vice versa, shall be installed in a manner similar to the work shown or described.
25. Plumbing Contractor shall provide temporary water service on the site to the locations indicated by the Construction Manager, on the site temporary fire protection water, all in accordance with requirements of the state and local codes, the Water Company and the Fire Department. Plumbing Contractor to pay all fees and obtain all permits required in connection with the water services.
26. Prepare and submit to the Engineer, all drawings, applications, test reports, correspondence, etc., as required in connection with the approval and installation of the backflow preventors and/or double check valves, as indicated on the Drawings or as required by the New York State Department of Health. Contractor shop drawings shall be suitable for filing with authority approving the installation. Engineer shall sign and seal as Engineer of Record.

1.3 RELATED WORK NOT INCLUDED

A. The following principal items of work shall be provided under other Sections; the General Contractor shall be responsible for coordinating the purchase of this work from other trades:

1. Finish painting.
2. Furnishing of toilet room accessories.
3. Installation of access doors. This Contractor shall furnish access doors.

4. Hospital equipment and casework, including stainless steel sinks in counters with tailpieces.
5. Base flashing for roof drains, and piping passing through roofs.
6. All electrical power wiring conduits, etc., for pumps, equipment, etc., shall be provided under Division 26.
7. Drainage piping from HVAC equipment to and spilling over floor drain, mop sink, sump or roof, except as noted.
8. Temporary toilets and water supply.
9. Finish patching.
10. Sheet metal gutters and leaders.

1.4 VISITING THE PREMISES

A. This Contractor, before submitting his bid on the work, shall visit the site and familiarize himself with all visible existing conditions. As a result of having visited the premises, this Contractor shall be responsible for the installation of the work as it relates to such visible existing conditions.

B. The submission of a bid will be considered as acknowledgment on the part of the bidder of his visitation to the site.

1.5 QUALITY ASSURANCE

A. Manufacturer's Instructions

1. In addition to the requirements of these Specifications, comply with the manufacturer's instructions and recommendations for all phases of the work.

B. Standards and Codes
Comply with the latest editions of the following:

Building Code of New York State
New York State Plumbing Code.
National Fire Codes (N.F.P.A.)
Local Gas Utility Rules and Regulations.
Local Municipal Rules and Regulations.
Local Fire Department requirements.
Local Water Company Rules and Regulations.
Other State and Local Authorities having jurisdiction.
F.M. and/or F.I.A. regulations.

C. All work and material not specifically described, but required for a complete and proper installation of the work of this Section, shall be provided by the Contractor and shall be new, first quality of their respective kinds, and subject to approval of the Architect.

D. All water supply connections to plumbing fixtures and other equipment to be installed under this Division shall be in accordance with the rules relative to submerged inlets and protective methods to be applied to prevent contamination of water as required by Local and State Regulations.

E. Manufacturing firms regularly engaged in manufacture of this material with characteristics and capacities required, whose products have been in satisfactory use in similar service for not less than 10 years.

F. Provide product produced by the manufacturers, which are listed in Section "Approved Manufacturer's List".

G. Provide equipment whose performance, under specified conditions, is certified by the manufacturer.

H. All piping shall be domestically manufactured and shall be by the same manufacturer.

I. All work shall be done by a licensed Plumbing Contractor.

1.6 ALTERATION WORK

A. All equipment, piping, plumbing fixtures, etc. to be removed shall be disposed of, turned over to the owner or salvaged as directed by the Owner. They shall not be removed from the premises without the Owner's approval.

B. All existing to remain piping that is rendered inoperable or orphaned by demolition shall be reconnected to nearest active systems during the completion of work in a given space. See additional requirements for shut-down coordination.

C. In instances where the removal of existing wall finishes reveals piping or systems that are not indicated for demolition, but are located in an area that conflicts with the proposed floor plan, the existing piping or system shall be relocated to a position that does not conflict with future finishes.

D. No dead ends shall be left on any piping upon completion of job.

E. Existing piping not planned for reuse, and not specifically noted or shown on Drawings to be abandoned shall be completely removed. All existing, unnecessary piping related to work being removed shall be completely removed.

F. The existing system shall be left in perfect working order upon completion of all new work.

G. Locations and sizes of existing piping are approximate. Exact sizes and locations of all existing piping shall be verified at the site.

H. No removed existing piping, fittings, valves, etc. shall be reused.

I. This Contractor shall not interrupt any of the services of the existing facility, nor interfere with the services in any way without the express permission of the Owner. Such interruptions and interferences shall be made as brief as possible and only at the time approved by the Owner.

J. Under no circumstances shall this Contractor or his workmen be permitted to use any part of the facility as a shop, except parts designated by the owner for such purposes.

K. Provide branch shut-off valves as required to install new work without continuous shut-down of entire building water supply and gas supply.

1.7 CONCRETE WORK

A. All concrete equipment bases that are installed on vibration isolators, all anchor and thrust blocks and all piping supports in trenches shall be provided under the work of this Section. All formed and poured-in-place concrete work including equipment housekeeping pads, sumps, etc., will be provided under another Division or Sections of these Specifications. The General Contractor shall be responsible for coordinating the purchase of this work from other trades.

B. This Contractor shall furnish all required templates for anchor bolts, and dimension drawings for housekeeping pads and sumps. All concrete provided under the work of this Section shall be in accordance with that specified under other Division or Sections of these Specifications. The General Contractor shall be responsible for coordinating the purchase of this work from other trades.

1.8 COOPERATION WITH OTHERS

A. The Plumbing Contractor shall cooperate with other trades whose work is to be correlated with his work, in order to avoid field interference, improper elevations, or inaccessible work. Any extra expense occasioned by lack of cooperation by this Contractor shall be borne by him.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION 220500

SECTION 220523 - PLUMBING VALVES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data including:

1. Dimensions
2. Sizes
3. End Connections
4. Weights
5. Installation instructions
6. Instructions on repacking and repairing valves.
7. Range of flow for balancing valves and plug valves.
8. Pressure reducing valves.
9. Backflow preventors.
10. All other applicable valves.

B. Valve Tag List: Refer to Section 22 05 53 of the Specifications.

PART 2 – PRODUCTS

2.1 GENERAL

A. Where type or body material is not indicated, provide valve with pressure class selected from MSS or ANSI standards, based on the maximum pressure and temperature in the piping system.

B. Except for balancing or when otherwise indicated, provide valve of same size as connecting pipe size.

C. Unless specifically required by note or symbol, all water valves shall be ball or gate valves. If ball, butterfly, globe, plug, or balancing valves are called out by note or symbol, only that type of valve is acceptable.

D. Where pipe sizes overlap, contractor has the option of threaded or flanged valves.

E. All valves shall be domestically manufactured.

F. Valves used for domestic water service shall be bronze or stainless steel. Iron and brass body valves are not acceptable. Comply with NSF-61 for lead free potable water piping.

G. All valves shall be of a design which the manufacturer lists for the service and shall be of materials allowed by the latest edition of the ASME Code for pressure piping for the pressure and temperature contemplated, unless a higher grade or quality is herein specified.

H. Valve packing compression is to be independent of the stem, ball or handle systems. All valve stems are to be blowout proof. Packing shall be accessible without disturbing the insulation.

2.2 GLOBE VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Crane
   b. Nibco
   c. Powell
   d. Gruvlok
   e. Stockham
   f. Hammond

B. Globe valves shall be of all bronze with composition disc, threaded or brazed joint ends as required by piping system in which they are installed.

C. All iron valves in potable water systems shall be NSF 61 listed and FDA approved epoxy coated cast iron valve bodies with bronze seats

D. Except where otherwise noted, all valves for use with copper tubing shall be as follows:

2” AND SMALLER	UNDER 300 PSI	Milwaukee Model UP1502 Bronze, 125 PSI SWP, 200 PSI WOG, Rising Stem, Screw Bonnet, Bronze Disk, MSS SP-80, Type 1, Solder Ends. Milwaukee Model 502 for Threaded Ends.

2.3 SWING CHECK VALVES

A. Manufacturers:

1. Design Basis: Nibco
2. Other Acceptable Manufacturers;
   a. Crane
   b. Milwaukee
   c. Powell
   d. Stockham
   e. Victaulic (for Grooved Pipe Systems)
   f. Gruvlok
   g. Hammond

B. Check valves up to and including 2" shall be all bronze swing check type with threaded or brazed joint ends.

C. For domestic water use up to 2” piping: Horizontal swing, regrinding type ASTM B 584 Alloy C87850 body, 300 PSI CWP, Y Pattern, Renewable PTFE Seat and Disc, MSS-SP-80, NSF-61 for potable water.

1. Model: UP509

2.4 SILENT/WAFER CHECK VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Metra Flex
   b. Hammond
   c. Nibco
   d. Tyco
   e. Victaulic (for Grooved Pipe Systems)
   f. Gruvlok
   g. Stockham

2” AND SMALLER	UNDER 200 PSI @ 250 °F	Milwaukee Model UP548T Bronze Body and Trim, Center Guided, Single Disc, 250 PSI Rating.

B. All iron valves in potable water systems shall be NSF 61 listed and FDA approved epoxy coated cast iron valve bodies with bronze seats

2.5 GATE VALVES

A. Manufacturers:
1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Crane
   b. Nibco
   c. Stockham
   d. Gruvlok
   e. Hammond

B. For domestic water use up to 3” piping: 300 PSI CWP, Screw-in Bonnet, Solid Wedge Disc, Non-Rising Stem, Gland Packed, Threaded Ends.

1. Model: UP105

C. All iron valves in potable water systems shall be NSF 61 listed and FDA approved epoxy coated cast iron valve bodies with bronze seats

D. All gate valves within the building shall be wedge gate valves with painted iron wheel handles, shall have gland followers in stuffing boxes, and shall be constructed that they may be repacked while open and under pressure. All valves shall have the name of the manufacturer and working pressure cast or stamped thereon.

E. All gate valves 3" and smaller shall be all bronze with brazed or screwed joint ends as required by the piping system in which they are installed.

2.6 BALL VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Apollo
   b. Dyna Quip
   c. Hammond
   d. Nibco
   e. Victaulic (for Grooved Pipe Systems)
   f. Watts
   g. Gruvlok
   h. Stockham

B. Cast bronze, 150, SWP, 600 WOG (min), ASTM 584 Alloy C89833 ball, two piece design, blow-out proof stem, adjustable packing gland nut (allowing handle to be removed without leaking) TFE seats, MSS-SP-110, NSF-61 for potable water.

1. Model: UPBA400 - full.port.

C. Options: Provide the following where required:

1. Extended stems for insulated valves.
2. Memory stop device for balancing applications.
3. Tee handle for tighter areas.
4. Hose end and cap for drain.
5. Mounting pads for actuator.
6. Provide “stop and drain” for compressed air.
7. Ball Valves up to 3” may be used for all water services as an alternate to gate valves, globe valves and balancing cocks.
8. Ball valves shall be bronze body, 316 stainless steel ball and stem, Teflon seats and seals threaded ends, 400 psig cold W.O.G. Worchester No. 411T-SE or equal.

2.7 CIRCUIT SETTERS (CS)

A. Manufacturers:

1. Design Basis: Bell & Gossett
2. Other Acceptable Manufacturers:
   a. Victaulic/Tour & Andersson

B. All valves to be of lead-free brass body/stainless steel ball construction with glass and carbon filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT insert and check valve. Valve bodies to have ¼” NPT tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to

have calibrated nameplate to assure specific valve setting. Valves to be leak-tight at full rated working pressure.

1. Model: Circuit Setter Plus

C. Valves ½" to 2" pipe size: NPT or sweat connections. Valves 2 ½' and 3" pipe size: NPT.

2.8 CIRCUIT SETTERS FOR DOMESTIC HOT WATER RECIRULATION

A. Manufacturers:

1. Design Basis: CircuitSolver

a. Model: CSUSF

B. Valve shall be a self-acting thermostatic recirculation valve that automatically and continuously maintains the end of each domestic hot water supply line at the specified water temperature. Valve shall regulate the flow of recirculated domestic hot water base on water temperature entering the valve assembly regardless of the system operating pressure. As the water temperature increases the valve proportionally closes dynamically adjusting flow to meet the specified temperature. Valve shall never fully close to allow sufficient bypass flow back to the recirculating pump. Coordinate closing temperature setpoint with system operating temperature.

C. Valve shall be capable of accomplishing a sanitary flush cycle. Valve will start to re-open above the low temperature balancing set point to allow the system to rebalance at the sanitizing flush temperature (temperature greater than 170 F).

D. All valve components to be made of lead-free materials. The major components that make up the balancing valve (body, plug, spring, actuator, etc.) to be constructed out of 303 stainless steel. Valve shall be NSF/ANSI 60 certified.

E. Valve assembly to be rated to 200 psig working pressure and 250 F maximum working temperature.

F. The thermal actuator to be spring-loaded and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.

G. Valve assembly shall be comprised of the thermostat balancing valve with integrated union body, check valve, ball valves (inlet & outlet) and a 20 mesh strainer.

H. All gate valves shall be similar and equal to Stockham G743-0 N.R.S. iron body, bronze mounted, double disc, parallel seat, mechanical

2.9 LOCAL EQUIPMENT AND FIXTURE PRESSURE REGULATORS

A. Furnish and install a CASH-ACME type HER or approved equal water pressure reducing valve on all cold and hot water branch lines for food service laboratory and medical equipment as provided under other Division of Sections of this Specification. Pressure reducing valves shall be of the differential type, self-contained, single seated, direct acting, spring locked type with no diaphragm. Valve body and spring housing shall be bronze and all other parts shall have a corrosion resistance equal to bronze.

B. All valves shall be sealed against leakage including a top cap over the adjusting screw.

C. Internal parts subject to wear shall be replaceable without removing valve from the pipe line, valve shall be provided with means to adjust outlet pressure setting.

D. Valves shall have sufficient water capacities to provide required rates of flow and shall be set at discharge pressure as required by the point of use.

2.10 BACKFLOW PREVENTER

A. Backflow Preventer (Atmospheric Vacuum Breaker)

1. Manufacturer:
   a. Design Basis: Watts No. 008 Series (3/8" through1")
   b. Construction: Bronze body, ball valve shut offs.
   c. Other Acceptable Manufacturers:
      1) Beeco
      2) Febco
      3) Wilkins
2. Complies with ASSE STD 1020.
3. Provide vacuum breakers on water supply piping to each fixture and equipment with submerged inlets, and on faucets and outlets, within the building, to which hose can be, or is attached, forming a submerged inlet. Set vacuum breakers in exposed readily accessible locations and at least 6'-6" above finished floor. Vacuum breakers shall be chrome plated brass, T&S Brass No. B-929-A watts 008 or approved equal. Vacuum breakers shall comply with ASSE STD 2010.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the following requirements:

1. Install valves with stems pointing up, and as close to vertical as possible.
2. Install valves at each piece of equipment, fixture or appliance so that the supply and return services can be shut off to remove the item without draining the remainder of the piping system.
3. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Install isolation valves at each concession, bathroom group and riser. Locate valves so as to be accessible.
4. Combination balancing and shut-off valves may be used instead of a separate balancing valve and shut-off valve if the valve has a memory stop and the manufacturer lists its use as a leak-proof service valve.
5. Provide drain valves at main shut-off valves, low points of piping and apparatus.
6. Provide separate support where necessary.
7. Do not allow meter connections of balancing valves to point downward.
8. Install valves so bypass valves are accessible.
9. Furnish all valves as indicated on the plans, or as may be required for the proper control of the pipe lines installed under this Specification, so that any fixture, line or piece of

apparatus may be cut out for repair without interference or interruption of the service to the rest of the Building. All water valves shall have a minimum working pressure of 125 psi, water rated unless otherwise noted on the Drawings or specified herein. All valves shall be of one manufacture. Provide valves with elevated pressure rating matched to service conditions where pressure exceeds 125 psi..

10. Drain valves shall be 3/4" heavy cast brass with composition washers with male thread for hose connections.
11. Provide at the high point of hot water piping system a 1/2" automatic IBBM air relief valve, 125 PSI, WOG Class. Pipe drain to spill over adjacent floor drain or service sink.
12. All valves on the exterior domestic and fire protection water piping shall comply with Local Water Company.
13. All valves shall have the trademark of the manufacturer and the guaranteed working pressure cast or stamped on the body of the valve. All gates or globes, etc., shall be of one manufacturer and working pressure cast or stamped thereon.
14. All valves for medical gases shall be U.L. listed and shall comply with the requirements of N.F.P.A. 96.
15. The entire plumbing systems shall be supplied with valves so located, arranged and operated as to give a complete regulating control to all fixtures and apparatus
16. Install check and globe valves on downstream side of the shutoff valve on hot water circulating riser and branch lines.
17. Valves, where exposed and used in connection with finished piping, shall be same finish as the pipe.
18. Provide shut-off valves and check valves on each pump discharge line.
19. All valves used on branch piping to bathroom and kitchens shall be all bronze type globe valves with discs suitable for service to which they are connected.
20. Install valves where required for proper operation of piping and equipment including valves in branch lines necessary to isolate sections of piping. Locate valves so as to be accessible.
21. Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.
22. Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves where corrosion is indicated or can be expected to occur.
23. Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.
24. Except as otherwise indicated, install gate, ball, globe, and butterfly valves to comply with ANSI B31.1. Where throttling is indicated or recognized as principal reason for valve, install globe valves.
25. Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.
26. Select and install valves with renewable seats, except where otherwise indicated.

B. All valves of a given type shall be of one manufacturer.

C. Provide extended stems on insulated system to prevent interference of operator with insulation.

D. Provide chain wheel operators for valves more than 7’ – 0” AFF in mechanical rooms and wherever shown on drawings.

3.2 VALVE APPLICATION

Domestic Hot and Cold Water ½" – 2"	Ball Valve

3.3 CHECK VALVE INSTALLATION

A. Swing and Check Valves:

1. Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.
2. Do not install in pump discharge piping.

B. Silent Check Valves:

1. Install in all pump discharge lines.
2. Silent check valves may be installed in vertical pipes with flow down upon Engineer's review for each instance.

C. Installation of Check Valves:

1. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position.
2. Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward.
3. Vertical Lift Check Valve: Install in vertical piping line with upward flow with stem vertically upward.
4. Spring Loaded Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward.

3.4 BACKFLOW PREVENTOR

A. Provide backflow preventors as follows:

1. Vacuum breaker at all hose bibs.
2. Stainless steel reduced pressure on water lines to ice makers.
3. Reduced pressure at laboratory and medical equipment.
4. Vacuum breaker at all mop sinks.

B. Provide drain opening and pipe to nearest floor drain or service sink.

3.5 CIRCUIT SETTERS

A. All circuit setters shall be installed per manufacturers recommendations. Provide manufacturers recommendation for required straight pipe for inlet and outlet connections to provide accurate ratings. Setting shall be as required for proper balanced flow to equipment.

B. Provide thermostatic balancing valve on all domestic hot water return lines.

C. Provide circuit setters on any lines requiring controlled flow.

END OF SECTION 220523

SECTION 220529 - PLUMBING PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 STANDARDS

A. Comply with MSS Standard Practice SP-58, SP-69 and SP-89, published by Manufacturer's Standardization Society of the Valve and Fitting Industry for type and size.

1.2 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Hangers other than clevis type.
2. Anchors.

B. Submit structural calculations for trapeze type supports.

PART 2 – PRODUCTS

2.1 PIPE HANGERS

A. General:

1. Use adjustable pipe hangers on suspended pipe. Trapeze hangers may be used at the Contractor's option. Contractor shall be responsible for sizing supports.
2. Chain, wire or perforated strap hangers will not be permitted.
3. Isolate hangers in contact with dissimilar materials with dielectric hanger liners. Tape is not acceptable.
4. Provide supports between piping and building structure where necessary to prevent swaying.

B. Hanger Rods:

1. Exposed in public areas: Zinc electroplated steel.
2. Concealed or in service areas: Black threaded steel.
3. Outside, exposed to weather: Hot dipped galvanized.

C. Spot Concrete Inserts: Steel case and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

1. Size inserts to match size of threaded hanger rods.
2. Inserts to be UL and FM listed.
3. Minimum 1000 lb. Capacity with ½" rod.

D. Channel Type Inserts:

1. Standard channel support with anchor tabs on 4" centers, and nail holes for attaching to forms.

2. Styrofoam inserts to prevent wet concrete seepage.
3. Minimum 2000 pounds/foot capacity.

E. Expansion Anchors:

1. For use only in renovations or where modifications to piping layouts require installation away from pre-installed insert locations.
2. Inserts shall be of the drill, insert, expand type. Power driven fasteners are not acceptable for piping.
3. Contractor shall select the appropriate type based on the following:

Rod Size	Maximum Working Load
3/8	600 pounds
½	1100 pounds
5/8	1800 pounds

F. Steel Structure Attachments:

1. Contractor may select welded or mechanically attached. All mechanically attached supports shall have jam nuts or other means to prevent loosening. Maximum loading requirements are as follows:

Rod Size	Maximum Working Load
3/8	600 pounds
½	1100 pounds
5/8	1800 pounds

G. Single Hangers:

1. Piping 2” and smaller: MSS type 1, Clevis hanger or type 7 adjustable swivel ring hanger. Minimum 180 pounds design load.
2. Piping 2” and smaller (steel): Clevis hanger, Anvil Fig. No. 260, F & M Fig. No. 239, Paterson Fig. No. 100.
3. Piping 2” and smaller (copper): Adjustable wrought iron, Anvil Fig. No. CT-65, F & M Fig. No. 364, Paterson Fig. No. 100 CT
4. Piping 2½” and larger: MSS type 1 Clevis hanger.
5. Piping 2½” to 4” (steel): Adjustable swivel pipe roll, Anvil Fig. No. 181, F & M Fig. No. 2729, Paterson Fig. No., 16.
6. Piping 2½” to 4” (copper): Adjustable wrought ring, Anvil Fig. No. CT-69.
7. Bare copper pipe: Above hangers, plastic or Neoprene coating, sized for copper pipe O.D. and copper coated for identification.
8. Insulated pipe: Hangers to be sized for O.D. of insulation. Hangers shall not penetrate any insulation.
9. Cast iron pipe above hangers sized for O.D. of cast iron pipe.
10. Hanger wire, cable or perforated metal strapping are not acceptable.

H. Trapeze hangers and wall supports:

1. Channel strut or structural steel shapes. Contractor shall follow channel strut manufacturers guidelines for loading or provide structural steel supports designed by a professional Engineer, licensed in the state where the project is located.

2. All piping shall be attached to the support by means of a channel strut clamp, U-bolt, or pipe rollers which will maintain lateral position of the pipe but allow longitudinal movement. Provide dielectric isolation between all dissimilar metals.
3. All insulation shall be continuous at supports. Do not notch or penetrate insulation.
4. Kindorf or similar materials used for support of small piping shall not be used for piping 3" or larger.
5. ½" through 3": Unistrut type channel and steel clamp.
   a. Use Hydrosorb cushions on copper pipe.

I. Vertical Supports: Provide steel riser clamp at each floor penetration or every 14 foot supported from wall bracket. Do not anchor riser clamps. In exposed locations, coordinate clamp locations with Architect.

J. Hangers:

1. General: Adjustable wrought steel clevis with locking nut attachment.
2. Multiple or Trapeze: Steel channels with welded spacers and hanger rods.
3. Hanger Sizes and Spacing:
   a. For drain piping, conform to the code requirements for spacing, and the following table for hanger rod sizes.
   b. For plumbing piping, conform to the following table:

PIPE TYPE	PIPE SIZE	MAXIMUM HORIZONTAL SPACING	MAXIMUM VERTICAL SPACING	MINIMUM HANGER ROD SIZE
Steel Pipe	½"	6'-0"	At every story height	3/8"
	¾" thru 1¼"	8'-0"		3/8"
	1½" and 2"	10'-0"		3/8"
Copper or copper- alloy tubing	1¼" and smaller	6'-0"	At each story height no greater than 10'	3/8"
Copper or copper- alloy tubing	1½ " and larger	10'-0"	At each story height no greater than 10'	3/8"
Copper Pipe	½" thru 1"	8'-0"	At every story height no greater than 10'	3/8"
	1¼" thru 2"	10'-0"		3/8"
	2½" thru 3"	10'-0"		1/2"
Cast Iron Soil	2"	5' And Each Joint	At base and at each story height no greater than 15'	3/8"
	3" to 5"	5' And Each Joint		½"

K. Insulated Pipe Supports:
1. Size pipe supports for outside diameter of pipe insulation.
2. It is not acceptable to cut or notch insulation at support locations.

L. Pipes over five inches and over 120º: Provide cast iron roller supports.

M. Beam clamps - Hangers supported from floor steel shall be approved I beam clamps. I beam clamps for hangers supporting piping 2 inches and smaller shall be C & P Fig. No. 148 adjustable beam clamps. For piping 2-1/2 inches and larger, I beam clamps shall be wrought steel. C & P Fig. No. 268 or equal.

N. Hangers for copper piping shall be copper plated.

2.2 INSULATION INSERTS

A. Pipe shall be protected at the point of support by an insert of high density, 100 psi, waterproofed calcium silicate, or Hi-Low Temp insert, encased in a sheet metal shield. Insert to be same thickness as adjoining pipe insulation. Insulation insert to extend one inch beyond sheet metal shield on all “cold” lines. If pipe hanger spacing exceeds ten feet and for all pipe roller applications, utilize double layer shield on bearing surface.

B. Provide 180º insulation inserts when utilizing clevis hangers. Provide 360º insulation inserts at all trapeze and wall supports.

2.3 PIPE ANCHORS

A. Manufacturers:
1. Design Basis: Flexonics
2. Other Acceptable Manufacturers:
a. Adsco
b. Keflex
c. Hilti

B. Model AC with threaded ends and welded angle brackets for steel pipe.

C. Model AC copper tube with solder ends and steel angle brackets brazed to tubing for copper tube.

D. Anchors may be field fabricated similar to manufactured products specified.

2.4 PIPE GUIDES

A. Manufacturers:

1. Basis of Design: B-line.
2. Other Acceptable Manufacturers:
a. Fee & Mason
b. Anvil
c. M-Co
d. PHD

B. Any of the Following:

1. Spider Type: B3281-7.
2. Roller Type: 2 sets of rollers on opposite sides of pipe.
3. Slide Type: B3893 with hold down lugs.

a. Not for use with cold piping.

4. Light duty, 1½" and smaller copper: U bolt or channel strut clamp (B2417) allowing clearance from O.D. of pipe or insulation.

2.5 ROOF MOUNTED PIPING

A. Manufacturers:

1. Miro Industries, Inc.
2. Portable Pipe Hangers, Inc.
3. Approved Equivalent.

B. Description: Where roofs are not being replaced, piping on roof shall be supported by an engineered prefabricated portable pipe system specifically designed to be installed on the roof without roof penetrations, flashing or damage to the roofing material. The system shall consist of recycled rubber or plastic bases, hot dipped galvanized or stainless steel frame with threaded rods and suitable pipe hangers and supports. The system shall be custom designed to fit the piping and conduits to be installed and the actual conditions of service.

C. Piping on areas of roof being replaced shall be installed on pipe curbs bearing on roof structure and flashed into roofing material.

D. Provide seismic restraints as required for seismic zone.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPE SUPPORTS

A. Adequately support piping from the building structure with adjustable hangers to maintain uniform grading where required and to prevent sagging and pocketing.

1. Provide supports between piping and building structure where necessary to prevent swaying.
2. Do not support pipe from other pipe or equipment.
3. Provide thrust restraints at all changes in direction on 8" and larger cast iron piping with no hub or hub and spigot fittings.

B. Install hangers to provide minimum ½" clear space between finished covering and adjacent work.

1. Place a hanger within one foot of each horizontal elbow.
2. Space hangers generally as called for in Table in Part 2, Products.

C. Use hangers, which are vertically adjustable 1-½" minimum after piping is erected.

D. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

1. Set inserts in position in advance of concrete work.
2. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.

3. Do not penetrate concrete “TT” legs for piping inserts. Do not penetrate the stressed (i.e. lower) chords of any structural member.

E. Provisions for Movement: Install hangers and supports:

1. To allow controlled movement of piping systems.
2. To permit proper movement between pipe anchors.
3. To facilitate the action of expansion joints, expansion loops, bends and offsets.
4. To isolate force due to weight or expansion from equipment connections.

F. In general, attach hangers to upper chord of roof trusses and floor joists, using long rods to facilitate pipe movement.

G. Anchors:

1. Arrange piping such that pipe expansion and contraction is accommodated by controlled movement of the pipe within the pipe supports. Provide sufficient offsets in branch piping to accommodate movement of main piping due to expansion and contraction. Where this is not possible due to magnitude of expansion or building geometry, securely anchor piping where required for a proper installation and to force the pipe expansion in the proper direction.
2. Anchors shall be suitable for the location of installation and shall be designed to withstand not less than five times the anchor load.
3. Anchor vertical pipes by means of clamps welded around pipes and secured to wall or floor construction. Anchor at bottom of riser only but provide guides for vertical thermal movement.
4. All anchors shall be separate and independent of all hangers, guides, and supports. Anchors shall be of heavy blacksmith construction suitable in every way for the work approved by the Architect. Anchors shall be welded to the pipe and fastened to the structure with bolts.
5. Anchors shall be fabricated and assembled in such a form as to secure the piping in a fixed position. They shall permit the line to take up its expansion and contraction freely in opposite directions away from the anchored points: and shall be so arranged as to be structurally suitable for particular location, and line loading. Submit details for approval.

H. Assume the responsibility for the proper transfer of the loads to the piping systems to the structure. No additional cost to the owner should be expected for any corrective work during construction.

I. Provide necessary structural members, hangers, and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported from metal decking and/or concrete construction, care shall be taken not to weaken decking and/or concrete or penetrate waterproofing. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.

J. Provide supplemental bolted steel in all locations where drilling of slab will create unacceptable noise in adjacent spaces.

K. Where piping is run near the floor and not hung from the ceiling construction but is supported from the floor, such supports shall be of pipe standards with base flange and adjustable top yoke similar to C & P Fig. 247 or equal.

L. All vertical piping shall be anchored by means of heavy steel clamps securely bolted or welded to the piping, and with end extension bearing on the building.

M. Vertical runs of pipe not over 15 feet long shall be supported by hangers placed not over one foot from the elbows on the connecting horizontal runs.

N. Vertical runs of pipe over 15 feet long but not over 60 feet long and not over 6 inches in size, or not over 30 feet long and not over 12 inches in size, shall be supported on heavy steel clamps. Clamps shall be bolted tightly around the pipes and shall reset securely on the building structure without blocking. Clamps shall be welded to the pipes or placed below couplings. Clamps shall be type 8, Federal Specification WW-H-171C, unless other types are approved.

O. Piping in trenches shall hang from angle iron cross supports provided by the Contractor with two coatings of red lead primer and final coat of black asphaltum paint.

P. Hanger rods shall be attached to preset concrete inserts with steel reinforcing rod through the insert and both ends hooked over the reinforcing mesh. For pipes 4 inches and larger, rods shall extend through concrete slab above where they shall be attached to steel bearing plates 6" x 6" x 1/4".

Q. Piping shall not be hung from other piping, ducts, conduits or from equipment of other trades and no vertical expansion shields will be permitted. Hanger rods shall not pierce ducts.

R. All piping running on walls shall be supported by means of hanger suspended from heavy angle iron wall brackets. No wall hooks will be permitted.

END OF SECTION 220529

SECTION 220549 - PLUMBING SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Locate, select, design, and install seismic restraints for all plumbing systems. Include restraints for piping and equipment.

1.2 CODES, STANDARDS

A. Comply with the requirements of the “Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems”, first edition.

B. Design seismic restraint systems for seismic Zone 2 with an effective peak velocity - related acceleration coefficient (A_v) of 0.10 to 0.19.

DESIGN LEVEL OF ACCELERATION AT EQUIPMENT CENTER OF GRAVITY			
SEISMIC ZONE 2, A_V = 0.10 TO 0.19			
ELEVATION ABOVE GRADE	RIGIDLY FLOOR OR WALL MOUNTED EQUIPMENT	RESILIENTLY MOUNTED AND/OR SUPPORTED FROM CEILING OR STRUCTURE ABOVE	LIFE SAFETY EQUIPMENT (FIRE ALARM, EMERGENCY)
BELOW GRADE UP TO 20 FEET ABOVE GRADE	0.100 “G” 0.125 “G”	0.500 “G”	1.000 “G”
21 FEET to 300 FEET	0.500 “G”	0.750 “G”	

1.3 SUBMITTALS

A. Submit manufacturer’s data for all manufactured restraints.

B. Submit shop drawings for all fabricated restraints.

C. Show restraint type and location on the sheet metal and piping shop drawings.

D. Provide an affidavit signed by a registered New York structural engineer certifying that all mechanical systems requiring such have been properly engineered and designed for seismic Zone 2.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design Basis: Mason

1. Other Acceptable Manufacturers:
   a. M.W. Sausse and Company, Inc.
   b. Vibration Mounting and Controls, Inc.
   c. California Dynamics Corporation
   d. By prior approval

PART 3 - EXECUTION

3.1 GENERAL NOTES FOR SEISMIC BRACING OF PIPES

A. Piping shall be designed with consideration given to the dynamic properties of the piping and the structure.

B. Bracing details, support details, schedules and notes listed in the Guidelines apply to all types of pipe and all type of joints.

1. Bracing
   a. Brace all pipes 2½" diameter and larger:
   b. Brace all piping 1¼" and larger located in boiler rooms, mechanical equipment rooms and refrigeration machinery rooms. Bracing requirements for pipes less than 2½" in diameter shall be the same as for 2½" pipes in all other locations.
   c. Seismic braces may be omitted:
      1) When the top of the pipe is suspended 12" or less from the supporting structure member and the pipe is suspended by an individual hanger.
      2) On all piping ¾" and smaller.
2. Details shown in the Guidelines provide a lateral bracing system. A typical vertical support system conforming to the above standard must also be used.
   a. Vertical Piping
      1) Attachment - Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and if over 2 stories in height at each floor by approved metal floor clamps.
      2) Screwed pipe (I.P.S.) shall be supported at not less than every other story height.
      3) Copper tubing - copper tubing shall be supported at each story for piping 1½" and smaller in diameter.
      4) Pipes of other approved material shall be supported in accordance with their approved installation standards.
   b. Horizontal Piping
      1) Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
      2) Screwed pipe - Screwed pipe (I.P.S.) or flanged pipe shall be supported at approximately 10 foot intervals.
      3) Copper tubing - Copper tubing shall be supported at approximately 6 foot intervals for tubing 1½" and smaller in diameter and 10 foot intervals for tubing 2" and larger in diameter.
      4) Pipes of other approved materials shall be supported in accordance with their approved installation standards.
3. Provide transverse bracings at 40' - 0" o.c. maximum unless otherwise noted in the Guidelines.

4. Provide longitudinal bracings at 80’ - 0” o.c. maximum unless otherwise noted in the Guidelines. When thermal expansion or contraction is involved, provide longitudinal bracings at anchor points. The longitudinal braces and the connections must be capable of resisting the force induced by expansion and contraction.
5. Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24” of the elbow or tee of similar size.
6. For threaded piping the flexibility may be provided by the installation of swing joints. In welded or solder joint piping the flexibility shall be provided by expansion loops or manufactured flexible connectors. For piping with manufactured ball joints select length of piping offset using “Seismic Drift” in place of “Expansion Per Joint Manufacturers” selection table. Seismic Drift = 0.015 ft. per foot of height.
7. Do not use branch lines to brace main lines.
8. Trapeze hangers may be used. Provide flexibility in joints where pipes pass through building seismic or expansion joints, or where pipes pass through building seismic or expansion joints, or where rigidly supported pipes connect to equipment with vibration isolators.
9. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with Lightweight concrete fill.
10. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.
11. A vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 30’ - 0” on center.
12. Cast iron pipe of all types, glass pipe and any other pipe joined with a shield and clamp assembly where the top of the pipe is 12” or more from supporting structure shall be braced on each side of a change in direction of 90^0 or more. Riser joints shall be braced or stabilized between floors.
13. For gas piping, the bracing details, schedules and notes may be used except that transverse bracing shall be at 20’ - 0” o.c. maximum and longitudinal bracing at 40’ - 0” o.c. maximum. Also 1”, 1¼”, 1½”, and 2” diameter pipes shall be braced the same as 2½” diameter pipe in the schedule. (No bracing is required for pipes ¾” diameter and smaller).
14. Proprietary bracing systems approved by OSA may be used in lieu of the braces shown in the details.

C. It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual pipe section.

D. Essential facilities or life safety equipment. “Essential facilities” mentioned in the Guidelines are those structures or buildings which must be safe and useable for emergency purposes after an earthquake in order to preserve the health and safety of the general public.

3.2 GENERAL NOTES FOR EQUIPMENT RESTRAINTS

A. Mechanical Equipment Anchorages such as bolts, expansion anchors, screws, etc., shall comply with the force level requirements of the above standards as well as the New York State Building Code.

B. Restraining Devices shall be designed to conform with the force level requirements of A above.

C. Restraining Devices must be placed on all sides of the equipment base.

D. It is the entire responsibility of the Equipment Manufacturer to design his equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

E. It is the responsibility of the Plumbing Contractor to ascertain and assure that an appropriate size device be selected for each piece of equipment (including whole unit restraints for internally braced equipment).

END OF SECTION 220549

SECTION 220553 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Plastic Pipe Markers and method of application.
2. Engraved Plastic Laminate Sign.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products.

B. Where more than a single type is specified for an application, selection is Installer's option, but provide a single selection for each application.

2.2 PLASTIC PIPE MARKERS (TYPE A)

A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.

B. For Pipes Less Than Six Inches (including insulation if any): Provide full-band pipe markers, extending 360º around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾" wide; full circle at both ends of pipe marker, tape lapped 1-½".

C. For Pipes Six Inches and Larger (including insulation if any): Provide either full-band or strip-type markers, but not narrower than 3 x letter height, taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-½" wide; full circle at both ends of pipe marker, tape lapped 3".

D. Lettering: Manufacturer's pre-printed wording which conforms to contract document system descriptions.

E. Where work is an extension or alteration of an existing system, new markers shall match existing terminology for systems which are modified or added by this work.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic (to accommodate both directions).

2.3 STENCILING (TYPE B)

A. Using a color contrasting to the surface to identify, spray or brush paint through neatly cut stencils.

B. Lettering shall conform to wording on contract documents. Size shall be in accordance with ANSI A13.1.

2.4 BACKGROUND COLOR AND STENCILING (TYPE C)

A. In addition to the requirements above, paint a background color band in accordance with ANSI A13.1.

2.5 VALVES TAGS

A. Brass Valve Tags: Provide manufacturer's standard 19 ga brass tag; approximately 1-½" round wit ½" high black filled numbers and 3/16" top hole.

1. Numbers shall be sequential in accordance with schedule below.
2. Provide separate numbering for each legend sequence. Provide separate sequences for the following:

a. Plumbing (PLBG)
b. Domestic Cold Water (DCW)
c. Domestic Hot Water (DHW)
d. Domestic Hot Water Return (DHWC)
e. All other systems (No legend)

B. Valve Tag Fasteners: Manufacturer's standard chain (wire link or beaded type), or S-hooks.

2.6 VALVE SCHEDULE

A. Provide schedule for each piping system, as defined on the drawings, and below, typewritten and reproduced on 8-½" x 11" bond paper.

B. Tabulate valve number, piping system, system legend (as shown on tag), location of valve (room or space), and variations for identification (if any).

C. Provide piping schematic for each system as defined below in Part 3.

D. In addition to mounted copies, furnish extra copies for maintenance manuals as specified.

E. Valve Schedule Frames: For each page of the valve schedule, provide a glazed frame, with screws for removable mounting on masonry walls.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, 1/16" thick, black with white core (letter color).

B. Fastening:

1. Screws
2. Rivets
3. Permanent Adhesive

C. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled in the construction documents.

PART 3 - EXECUTION

3.1 GENERAL

A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, install identification after completion of covering and painting.

B. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers on piping of the following systems and include arrows to show normal direction of flow.

1. Domestic water piping (hot, cold, tempered; 120º hot, 180º hot, hot water re-circulating, etc.).
2. Plumbing vent and sanitary (above grade) piping.
3. Storm piping.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces above accessible ceilings, in accessible maintenance spaces, including chases, and above ceiling:

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where there could be a question of flow pattern.
3. Near locations where pipes pass through walls, floors, or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 50’ along each piping run.
6. Within 6’ of access doors above otherwise non-accessible ceilings and chases.

C. Type:

1. Normally exposed to view - Type A or C.

2. Normally concealed from view - Type B.

3.3 VALVE IDENTIFICATION

A. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixtures faucets, hose bibs, and shut-off valves at plumbing fixtures, and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.
   1. Shut off valves located at least 10’ from fixture(s) shall be provided with valve tag unless otherwise directed by Engineer.

B. Mount framed valve schedules with piping schematics where directed by Architect.

C. Identify each valve tagged on as-built drawings.

3.4 NON-POTABLE WATER IDENTIFICATION

A. Provide an engraved plastic laminate sign.

   1. Legend: “Non-Potable Water”.
   2. Location: At each outlet of piping between backflow preventer and equipment served. (e.g. Boiler Room hose bibb).

END OF SECTION 220553

SECTION 220593 - TEST-ADJUST-BALANCE

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. A work of this section shall be completed by a sub-contractor of the Plumbing contractor.

B. The Balancing Contractor shall not be a sub-contractor of any other Division 21, 22 or 23 Contractor.

1.2 QUALITY ASSURANCE

A. Qualification:

1. The firm shall be an independent testing and balancing firm specializing in testing and balancing of environmental systems.
2. The firm shall have an experience record of not less than five (5) years experience in the testing and balancing industry.

B. Registration: Work shall be done under the supervision of a professional engineer registered in the jurisdiction of the work. Engineer shall be available for all meetings and interpretation of all materials in the report.

C. Pre-qualification of Testing and Balancing Contractor.

1. The firm must have experience and qualifications satisfactory to the consulting mechanical engineer and must be accepted by him prior to bidding.
2. Firms desiring approval to provide work under this section shall submit a booklet indicating procedures and data forms that they would use in the performance of the work.
3. Only firms which have been approved by the engineer may provide work under this section.

PART 2 - PRODUCTS

2.1 PRODUCTS (Not applicable)

PART 3 - EXECUTION

3.1 GENERAL

A. Sequence work to commence after completion of system and start-up procedures and schedule completion of work before Substantial Completion of Project.

B. Examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.

C. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work.

1. Do not proceed with the work until unsatisfactory conditions have been corrected.
2. Provide Engineer/Architect with a copy of the notification.

D. Adjust flows to within 10% of values shown. If design flows cannot be obtained within specified limits the Balancing Contractor will perform the following (at the minimum):

1. Measure and record major pressure drops in the system.
2. Consult with the Engineer and Installer as required.
3. Upon receiving written directions to proceed and after any corrections are performed, re-balance affected portion of system.

E. Optimization: Work closely with the plumbing contractor to optimize setpoints.

1. Establish the minimum water differential pressure for variable or bypass flow system.
2. Establish the position of valve and sequencing relays.
3. Confirm suitable operation of all backflow prevention devices.
4. Confirm proper operation of hot water return system.
5. Confirm proper flow through all heat exchangers.

F. Patch holes in insulation and housings which have been cut or drilled for test purposes, in a manner recommended by the original Installer.

G. Make all final readings for each system at the same time, and after all adjustments have been made.

H. Mark equipment settings, including control positions, balancing cocks, circuit setters, valve indicators, to show final settings at completion of test-adjust-balance work.

1. Mark with paint or other suitable permanent identification material.

I. Check all new thermal overloads.

1. Identify improperly protected equipment in report.

J. All piping and equipment shall be tested; labor including standby electrician, materials, instruments and power required for testing shall be furnished unless otherwise indicated under the particular section of the Specification.

K. Tests shall be performed in the presence and to the satisfaction of the Architect and such other parties as may have legal jurisdiction.

L. In no case shall piping, equipment, or accessories be subjected to pressure exceeding their ratings.

M. All defective work shall be promptly repaired or replaced and the tests shall be repeated until the particular system and component parts thereof receive the approval of the Architects.

N. Any damage resulting from tests to any and all trades shall be repaired and damaged materials

replaced, all to the satisfaction of the Architect.

O. The duration of tests shall be as determined by all authorities having jurisdiction, but in no case less than the time prescribed below.

P. Equipment and systems which normally operate during certain seasons of the year shall be tested during the appropriate season. Tests shall be performed on individual equipment, systems, and their controls. Whenever the equipment or system under test is interrelated and depends upon the operation of other equipment, systems and controls for proper operation, functioning and performance, and latter shall be operated simultaneously with the equipment or system being tested.

Q. All pumps and piping systems shall be completely balanced by the adjustment of the plug cocks, globe valves or other control devices, to obtain the flow quantities indicated on the design drawings.

R. An initial hydrostatic test shall be conducted for all press connect system to identify any unpressed fittings. Initial rest shall be between 15 and 85 psi. This test shall be done prior to conducting the final hydraulic test identified below.

S. All piping shall be tested to a hydrostatic pressure at least 1-1/2 times the maximum designed working pressure unless a higher pressure is required elsewhere (but not less than 50 psi) for a sufficiently long time to detect all leaks and defects; and after testing shall be made tight in the most approved manner. Tests shall be repeated once after leaks and defects have been repaired. When automatic-control valves and similar devices are incapable of withstanding test pressures applied to piping, such devices shall be removed, or otherwise protected during tests. After completion of such tests, devices shall be installed and tested with the operating medium to operating pressures.

3.2 DOMESTIC WATER SYSTEMS

A. Before any adjustments are made:

1. Check temperature control valve operation.
2. Check pump rotation.
3. Adjust pressure reducing valve.
4. Remove any roughing strainer screens in systems.

B. Procedure:

1. Measure and report all domestic water recirculation systems by all of the below means which are applicable.
   a. System, pump, branch, or terminal flow measuring stations.
   b. Terminal or heat exchanger pressure drop, compare to submittal data.
   c. Plot operating point on system graph.

3.3 REPORT

A. Provide a general information sheet listing:

1. Instruments used:
   a. Most recent calibration date.
2. Method of balancing.
3. Altitude correction.
4. Manufacturer's performance data for all air devices used.

B. Provide data sheets for all equipment, including motors and drives, listing:

1. Make
2. Size
3. Serial number
4. Capacity Rating
5. Amperage
6. Voltage input
7. Thermal heater size for each motor
8. Operating speed of driver and driven devices
9. Any additional pertinent performance data

C. Include design and final values for all items listed in Detailed Requirements, and totals for each system.

D. Provide data sheets showing:

1. Instrument used
2. Velocity reading
3. Manufacturer's free area factors

E. Provide recap sheet with explanation for each device not meeting specified performance.

F. Provide a set of prints with equipment, inlets and outlets marked to correspond to data sheets.

3.4 COMMISSIONING

A. Provide all necessary personnel, tools and equipment to comply with the commissioning scope.

END OF SECTION 220593

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Insulation.
2. Jackets, coatings and protective finishes.
3. Sealers, mastics and adhesives.
4. Fitting covers.

1.2 FLAME AND SMOKE RATINGS

A. Provide insulation tested on a composite basis (insulation, jacket, covering, sealer, mastic and adhesive) complying with the following for:

1. Flame Spread: 25 or Less
2. Smoke Developed: 50 or Less
3. Method: ASTM E84 (NFPA 255), UL 723

B. Accessories such as adhesives, mastics, cements, tapes and cloths for fittings shall have component ratings as listed above. All products shall bear UL labels indicating the above are not exceeded.

1.3 PRODUCT DELIVERY

A. Deliver insulation products in factory containers bearing manufacturer's label showing fire and smoke hazard rating, density and thickness.

B. Protect insulation against, dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

C. Store insulation in original wrappings and protect from weather and construction traffic.

1.4 DEFINITIONS

A. Exposed Location: Located in mechanical rooms or other areas exposed to view.

B. Concealed Location: Located in pipe chases, furred spaces, attics, crawl-spaces, above suspended ceilings, or other locations not exposed to view.

1.5 STANDARDS

A. Comply with the latest edition of National Commercial and Industrial Insulation Standards.

B. Provide certifications or other data as necessary to show compliance with these Specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. Manufacturers:

1. Design Basis: Johns-Manville
2. Other Acceptable Manufacturers:
   a. Armacell
   b. Foster
   c. Owens-Corning
   d. Knauf
   e. KFlex USA
   f. Imcoa
   g. Pittsburgh Corning

B. Materials:

1. Fiberglass Pipe Insulation with Vapor Barrier: Johns-Manville Micro-Lok heavy density pipe insulation with AP-T jacket or Owens-Corning Fiberglass Corp. ASJ/SSL-11.
2. Fiberglass Pipe Fitting Insulation: Johns-Manville “Zeston” fitting covers with factory-cut fiberglass insulation insert. Insulation blanket with foil tape and tie wire will not be accepted.
3. Flexible Unicellular Pipe Insulation: Armstrong Armaflex, II or Therma-cel By Nomaco.
4. Cellular glass with vapor barrier coating: Pittsburgh Corning.
5. Rigid Closed Cell Insulation: ITW Insulation Trymer 2000 XP(not for use indoors).
6. Vapor Barrier Mastic: Foster 30-65 or Childers CP-34; permeance shall be 0.03 perms or less per ASTM E96. Mastic must meet California Dept. of Public Health (CDPH) Standard Method Ver. 1.1,2010 Small Scale Environmental Chamber Test for VOCs. for CA Specification 01350 and LEED IEQ 4.2.
7. Weather Barrier Mastic: Foster 46-50 or Childers CP-10/11. For use on hot service pipe.
8. Lagging Adhesive: Foster 30-36 or Childers CP-50AMV1.
9. Fiberglass Adhesive: Foster 85-60 or Childers CP-127.

C. Thickness: (Thickness listed below are minimum required. Provide thickness required by Local Building or Energy Codes). [Spec Writer: Confirm thickness with Local Energy Code. Also, add to this list any unique cases i.e., grease waste, exposed to freezing, etc.]

1. Service (Domestic) Water Piping:
   a. Hot:
      1) 1½ ” and Smaller: 1½ ”
      2) 2” and Larger: 2”:
      3) Non Recirculated Runouts smaller than 1.5” and 8 feet long within conditioned spaces:1"
   b. Cold: 1½”
2. Storm Water:
   a. All Sizes: 1”
3. Repairs to Existing Insulation: Match thickness of existing insulation.
4. All Heat Traced Piping:
   a. Size 2” and smaller: 1”
5. Waste/Sanitary:

a. All waste receptors, and associated branch pipe back to main, receiving waste from freezer drips, ice makers, ice bins and A/C condensate drains shall be provided with 1” of insulation.
b. Indirect waste piping from freezer drips, ice makers and ice bins shall be provided with 1” of insulation.

D. Application: Unless otherwise indicated, use the following:

1. Inside, concealed: Fiberglass with a maximum K factor of 0.22 BTU/inch per sq. ft. per degree F. per hour at 75˚F. mean temperature with factory-applied all service vapor proof jacket. Density shall be not less than 3 lbs. per cubic foot. For hot pipe insulation, insulation shall be suitable for 250˚F.
2. Inside, exposed: Fiberglass pipe insulation with vapor barrier and PVC jacket (jacket not required in mechanical rooms).
   a. A vapor barrier mastic compatible with the PVC shall be applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. The PVC fitting cover is then applied and shall be secured with pressure sensitive pearl gray Z-Tape along the circumferential edges. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side.
   b. 2 or more layers of the Hi-Lo Temp insulation inserts shall be applied with the first layer being secured with a few wrappings of fiberglass yarn.
   c. Qualifications for Using Insulation: Use one Hi-Lo Temp insert for each additional 1" of pipe insulation.
   d. Fitting Cover: the temperature of the PVC fitting cover must be kept below 150˚F by the use of proper thickness of insulation and by keeping the PVC cover away from contact with, or exposure to, sources of direct or radiant heat.
3. PVC: 1½” thick fiberglass (duct) insulation, or 1” heavy density pipe insulation installation to meet ASTM E84 (NFPA 255) flame spread and smoke developed ratings.
4. All fittings, valves and flanges for pipe sizes 4" and larger shall be insulated with fabricated mitered segments of pipe insulation of same thickness as the adjoining pipe insulation, secured with no. 20 gauge galvanized annealed steel wire and covered with Zeston 2000 molded PVC fitting covers as manufactured by Manville or equal.
5. Direct contact between pipe and hangers will not be accepted. Hangers shall pass outside of a metal saddle which shall cover a section of high density insulation of sufficient length to support pipe without crushing insulation. Hangers shall not pierce insulation and all vapor barriers shall be unbroken and continuous. High density insulation shall be one of the following:
   a. Foam glass.
   b. Fiberglass, high density, minimum of 7 lb. material or heavier.
   c. High density calcium silicate insulation.
6. Provide vapor barrier dams at locations and intervals recommended by the insulation manufacturer, maximum 20’ spacing.

2.2 EQUIPMENT INSULATION

A. Manufacturer:

1. Design Basis: Johns Mansville
2. Other Acceptable Manufacturers:
   a. Armstrong
   b. Certainteed

c. Owens-Corning
d. Knauf
e. Pittsburgh Corning

B. Materials:

1. Insulation: 3" thick flexible board type insulation. 3 PCF glass fiber insulation with all purpose jacketing. Maximum thermal conductivity .27 BTU-IN/(hr-FT^2-ºF) at 150ºF. Glass fibers oriented such that insulation will conform to rounded shapes while maintaining high compressive strength.
2. Jacketing Material: PVC or aluminum jacketing material, except as otherwise indicated. Seal all joints.
3. Fiberglass: Johns-Manville Micro-Lok 850 insulation with APT jacket.
4. Flexible Unicellular Insulation: Armstrong Armacell sheet form.

C. Application:

1. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, metal covers, adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify acceptability of all materials which are to be used in air plenums (above ceiling, etc.). Materials must meet all requirements of Local Building Code and Authority having jurisdiction.

B. Insulation Packing:

1. Piping:
   a. Wherever piping penetrates walls, partitions, floor slabs, etc., the space between the piping and the sleeve shall be packed with mineral wool and sealed with approved type non-hardening caulking compound for sleeves through exterior walls.
2. Material:
   a. Packing material shall be rockwool insulation as manufactured by United Stated Gypsum Co. or equal and shall comply with Fed. Spec. HH-1-558, Form A, Class 4, K=0.24, melting point 2000˚F.

C. All Lines That Are Electrically Traced

1. The basic insulation shall be dual temperature, Manville Micro-Lok piping insulation, 1-1/2" thick. The insulation shall be sized to accommodate the electric heat tracing applied against the pipe surface.
2. Finish for insulation shall be .02 aluminum.

D. Contractor shall examine location where this insulation is to be installed and determine space conditions and notify the Architect in writing of conditions detrimental to proper and timely completion of the Work.

E. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. Install insulation in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that insulation complies with requirements and serves intended purposes.

B. Coordinate with other work as necessary to interface installation of insulation with other components of systems.

C. All insulating materials shall be applied only by experienced workmen, in accordance with the best covering practice. All piping equipment shall be blown out, cleaned, tested and painted prior to the application of any covering. Adhesives, sealers and mastics shall not be applied, when the ambient temperature is below 40˚F, or surfaces are wet.

3.3 PIPE INSULATION

A. Insulate the following:

1. Domestic hot water piping.
2. Domestic cold water piping above ground and under slab.
3. Roof drain bodies and all storm water piping.
4. All existing piping which is currently insulated and which is modified as a result of this work.
5. Heat traced piping.
6. All storm piping in areas provided with humidification control.

B. Installation:

1. Install insulation on pipe system subsequent to testing and acceptance of tests.
2. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete the run. Do not use cut pieces or scraps abutting each other.
3. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
4. Extend piping insulation without interruption through pipe clamps, hangers, walls, floors and similar piping penetrations, except where otherwise indicated.
5. Install protective metal shields and saddles where needed to prevent compression of insulation.
6. Except as noted, cover valves, flanges, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.
   a. Install factory-molded, pre-cut or job-fabricated units (at Installer’s option), except where a specific form or type is indicated.
   b. Do not cover:
      1) Valve operators. Provide extended valve stems as required to maintain continuous insulation and vapor barrier.

2) Nameplates or identification tags.
c. Provide removable access for:
1) Strainers.
2) Other components requiring access for service.

7. Mark location of unions and flanges covered by insulation with permanent paint or ink, or approved label.
8. Maintain integrity of vapor-barrier jackets on insulation of cold pipes and storm drainage piping, and protect to prevent puncture or other damage. Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold services shall be adequately insulated and vapor sealed to prevent condensation.
9. Inserts shall be installed at hangers for insulated piping. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths:

2-1/2" pipe size and smaller	6" long – 18 GA
3" to 6" pipe size	9" long – 16 GA

10. Provide 18 gauge galvanized metal shields between hangers or supports and pipe insulation. Form shields to fit insulation. Extend shields up to centerline of pipe. Make shields same length as that specified above for inserts.
11. Where insulation is specified for piping, insulate similarly all connections, vents, drains, and any piping connected to system.
12. Fill surface imperfections such as chipped edges, small joints or cracks and voids or holes with insulation material and smooth all such areas with a skim coat of insulating cement.
13. Seal ends of sections with Foster 30-65 or Childers CP-34 vapor barrier mastic and reinforcing mesh to crate moisture dams at:
a. 20 ft. intervals.
b. Valves and fittings.
c. All hangers and supports.
14. Replace existing insulation removed or damaged because of work of this project.
15. Insulate new pipes and replace insulation on existing pipes to remain where insulation was removed or damaged by demolition or revisions.
16. Insulate between fingers of spiders in alignment guides.
17. Insulate between pipe and pipe slide.
18. All domestic water piping installed within piping chases behind fixtures (“crotons”) must be fully insulated to the back of the wall behind the fixture.
19. All equipment shall be insulated, including circulator pumps, circuit setters, strainers, etc. Provide valve and trim extensions as required to maintain the minimum insulation thickness.
20. Perform all work in a neat and workmanlike manner. Poor work (as determined by Architect or Engineer) will be cause for rejection.
21. Specialties shall be insulated to match those of the systems to which they are connected.
22. No insulation shall be installed until the piping systems have been hydrostatically tested as specified elsewhere to the satisfaction of the Engineer.

3.4 EQUIPMENT INSULATION

A. Install insulation materials with smooth and even surfaces and on clean and dry surfaces, after inspection and release for insulation application.

1. Re-do poorly fitted joints.
2. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

B. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

C. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

D. Do not insulate handholes, cleanouts, ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

E. Do not apply insulation to equipment above 125° F.

3.5 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including any damage to continuous vapor barrier or damage due to moisture saturation. The insulation installer shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

3.6 ASBESTOS REMOVAL

A. It is understood and agreed that this work does not contemplate handling of, or design including use of, asbestos or any hazardous waste material. Therefore, Owner and Contractor agree to hold harmless, defend and indemnify consultant (A/E) for all claims, lawsuits, expenses or damages arising from or related to the handling, use, treatment, purchase, sale, storage or disposal of asbestos, asbestos products or any hazardous waste materials.

B. In the event asbestos is encountered the Contractor shall immediately cease work in the area of the asbestos shall contact the Owner for instructions.

C. Site Monitoring:

1. Follow Section 1910.1001 Code of Federal Regulations Title 29, Part 1910 (OSHA Asbestos Regulations).
2. Provide daily sampling during removal instead of at six month intervals.
3. Stop work and notify Architect immediately if levels exceed those of Subparagraphs b (2) or b (3) of regulations.

END OF SECTION 220700

SECTION 221000 - PLUMBING PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract and Division 1 Specification Sections (General Requirements), apply to this Section.

1.2 SUBMITTALS

A. Submit manufacturer's data on the following:

1. Water hammer arresters.
2. Roof drains, floor drains, floor sinks, cleanouts and area drains.
3. Downspout nozzles.
4. Trap primers.
5. Cleanouts.
6. Dissimilar Metals.
7. Pipe Sleeves.
8. Stack Sleeves.
9. Drip Pans.

1.3 STANDARDS

A. Materials shall comply with the latest editions of the following standards.

1. Plumbing Code of New York State
2. Cast iron: ASTM A-74-87
3. Cast iron pipe fittings ASTM A-888
4. Cast iron pipe couplings ASTM C-564
5. Copper pipe:
   a. Type K, L, M: ASTM B88
   b. DWV: ASTM B306-88
6. Ductile iron pipe: ASTM A377-89
7. All potable water piping and fixtures should be compliant with NSF-61 requirements for lead free piping
8. All piping shall be domestically manufactured and shall be by the same manufacturer.

1.4 RELATED WORK

A. Section 22 05 29 Pipe Supports and Anchors.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING AND ACCESSORIES

A. Comply with NSF-61 for lead free potable water piping.

B. Above Ground Inside Building, Size 6” and Under:

1. Pipe: Copper, hard temper, Type L, ASTM B88.
2. Fittings:
   a. Wrought copper, or cast bronze.
   b. ASME B16.22 wrought copper fittings or ASME B16.18 bronze castings with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).
3. Solder:
   a. 95-5 tin antimony (no lead), ASTM B32.

C. Use approved fittings for connections between dissimilar pipe systems.

2.2 TRAP PRIMERS (TP)

A. Manufacturers:

1. Design basis: PPP as noted in Plumbing Fixture Schedule.
2. Construction: Corrosion resistant brass. “O” rings shall have a flexibility range of -40°F to 450°F.
3. Provide distribution units for connector points as shown on plans.
4. Complies with ASSE STD 1018.

2.3 WATER HAMMER ARRESTER (Shock Absorber)

A. Manufacturers:
1. Design Basis: Zurn Shoktrol Z-1700
2. Construction: Stainless Steel, Bellows
3. Other Acceptable Manufacturers:
   a. Josam
   b. Sioux Chief
   c. J.R. Smith
   d. MIFAB-WHB
4. Standards: PDI WH201, ASSE STD 1010.

B. Install permanently sealed water hammer arrestors on all hot and cold water branches and headers to plumbing fixtures whether it is indicated on the Plumbing Drawings or not.

C. Shock absorbers are to be of size and location in accordance with the manufacturer's recommendations and with DPI Standard WH 201 and shall be PDI approved. Provide accessibility to all shock absorbers.

D. Provide shock absorbers at the top of water risers and at all quick closing valves, solenoid valves and at equipment such as sterilizers, washers, etc.

2.4 SANITARY AND VENT PIPING (WITHIN BUILDING)

A. Above Ground:

1. Cast iron hub and spigot, neoprene gasket.

2. Cast iron no hub, neoprene gasket and stainless steel sleeve joint (as allowed by jurisdiction). ASTM A888, CISPI 301.

2.5 HEAVY DUTY NO HUB COUPLINGS

A. Use on the following:

1. Sanitary vent piping 4” and larger.
2. Sanitary piping 3” and larger.
3. All storm piping.

B. 1-1/2”, 2”, 3” and 4”: 3” wide 304 stainless steel shield; (4) minimum stainless steel clamps; fixed and “floating” eyelet.

C. 5” and over: 4” wide 304 stainless steel shield, with six (6) stainless steel clamps mounted in series.

D. Torque to minimum 80 inch pounds or per manufacturer’s recommendation.

E. Acceptable manufacturers: Husky Series 2000 or Mission Heavy Weight.

2.6 STANDARD DUTY NO HUB COUPLINGS

A. Standard duty couplings shall conform to CISPI 310-85: 0.008” thick corrugated stainless steel. ASTM A888.

B. Use of the following:

1. Sanitary vent piping up to and including 3” piping.
2. Sanitary piping up to and including 2” piping.
3. As allowed by jurisdiction.

C. Torque to inch pounds per manufacturer’s recommendation.

D. Acceptable manufacturers: Tyler, Mission, AB&I, Clamp All, Huskey.

2.7 SOIL AND VENT PIPING ACCESSORIES

A. Use approved fittings for connections between dissimilar pipe systems.

B. Acceptable Manufacturers:
1. Josam
2. Wade
3. Zurn
4. J.R. Smith
5. Jones Spec
6. Watts Ancon

C. Cleanout Plugs:

1. Material: Cast bronze or brass.

2. Type: Countersunk.
3. Threads: ANSI B2.1.

D. Wall Cleanout Covers:

1. Type: Frameless, round, low profile plate.
2. Material: Stainless steel or chrome plated brass.
3. Attachment: Single exposed flush screw.
4. Finish:
   a. Non-painted surfaces: Bright polished.
   b. Surfaces to be painted: Prime coat.

E. Floor Cleanouts:

1. Body: Standard round Duco cast iron.
2. Attachment: Bronze screws.
3. Sleeve: Full thickness of floor slab.
4. Top:
   a. Shape:
      1) Where floor covering has rectangular pattern: Square.
      2) Other areas: Round.
5. Cover:
   a. For Vinyl Tile and Similar Floor Coverings: Recessed to receive inset of floor material.
   b. For carpeted floor covering provide carpet cleanout marker.
   c. Other areas: Nickel bronze scoriated finish.

F. Vandal-Proof Caps

1. Material: Duco cast iron.
2. Attachment: Recessed Allen set screw.

2.8 STORM WATER PIPING (INSIDE BUILDING)

A. Above Ground:

1. Cast iron, hub and spigot, neoprene gasket joints.
2. Cast iron no hub, neoprene gasket and heavy duty no hub couplings.

2.9 STORM DRAINAGE PRODUCTS

A. Roof Drain: (RD)
1. Material: Cast Iron
2. Dome: Cast Iron
3. Include:
   a. Combined flashing collar and gravel stop.
   b. Extension for insulation.
   c. Under-deck clamp.
   d. Sump receiver.
   e. Expansion joint.

B. Overflow Roof Drain: (OD)
   1. Same as Roof Drain Type 1 except:
      a. Provide removable water dam. Top of water dam shall be 4” above low point of roof.
   2. Provide (1) overflow roof drain for every roof drain shown.

C. Downspout Nozzle
   1. Material: Cast Bronze
   2. Manufacturer: Zurn
   3. Model: 1770

D. See Plumbing Fixture Schedule and Plumbing Fixture specification for additional information.

2.10 DISSIMILAR METALS

A. Connections between pipe, fittings, hangers and equipment of dissimilar metals shall be insulated against direct contact one with the other, by using a high quality or grade of dielectric insulated material

B. Dielectric unions or insulated couplings shall be installed between copper or brass piping material and steel piping material or steel tanks. Unions or insulated couplings shall be used for pipe sizes 2” and smaller, and dielectrically gasketed flanges and sleeves for pipes 2-1/2” and larger.

C. Dielectric fittings shall be installed between copper and steel piping systems to prevent galvanic corrosion. Body shall be ductile iron or steel, zinc electroplated, with LTHS high temperature, polyolefin polymer lining and grooved or threaded ends. Victaulic Style 47.

2.11 PIPE SLEEVES

A. Any pipe required in walls and floors shall be provided with a pipe sleeve.

B. Provide watertight sleeves for all pipes penetrating exterior foundation walls and waterproof floor areas and where such areas are noted on the Architectural and Structural Drawings.

C. Except where indicated or specified otherwise, provide and install Schedule 40 galvanized steel sleeves for all piping passing through concrete walls or floor slabs. Sleeves shall be securely set in the framework and where not specified otherwise shall be of such length as to extend flush with each face of the wall in which they are installed, 3" above unfinished floor and 2" above the finished floor or tile, as applicable. Sleeves in kitchen and laundry areas shall be chrome plated.

D. Sleeves shall have an internal diameter of at least 1" larger than the outside pipe size diameter of the pipe passing through them. Sleeves in exterior foundation walls shall be James B. Clow and Sons, No. F-1430 or F-1435, or approved equal, extra-heavy cast iron wall sleeves with intermediate integral flange. Cast iron wall sleeves with intermediate integral flange. Cast iron sleeves shall be set with end flush with wall faces.

E. Where sleeves penetrate waterproofing, install caulking between pipes and pipe sleeves as follows:

1. Pack oakum to a depth of 1" between pipe and pipe sleeve at a location permitting 3" of sealant to be installed above the oakum.
2. Fill space above oakum to a depth of 3" with sealant similar and equal to Igas Joint Sealer as manufactured by Silka Chemical Corporation.

F. Sleeves for gas piping shall extend 4 inches beyond exterior face of wall and 1 inch beyond inner face.

G. Sleeves in waterproof floors shall be as manufactured by Zurn Inc. or equal, cast iron sleeve with integrally cast flange and flashing device.

2.12 STACK SLEEVES

A. Stack sleeves for pipes passing through roof shall be equal to Zurn Z-195-10 or MIFAB R1900 with cast iron body, adjustable flashing ring, rust resistant bolts, and under deck clamp. The adjustable flashing ring shall be caulked after it is in the proper position. The space between the flashing sleeve and the pipe passing through same shall be caulked watertight.

2.13 CLEANOUTS

A. Provide easily accessible cleanouts at base of vertical stacks and leaders; at ends of horizontal drainage lines and at intervals not exceeding 50 ft.; at each change of direction; on hand holes of running traps; and where indicated to make entire drainage system accessible for roding. Provide at least 18 inch clearance to permit access to cleanout plugs.

B. Cleanouts for cast iron pipe shall consist of tapped extra heavy cast iron ferrule caulked into cast iron fittings, and extra heavy brass screw plug with solid hexagonal nut.

C. Cleanouts turning out through walls and up through floors shall be made by long sweep ells of "Y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in room. Where no definite finish is indicated on the Architectural and/or Mechanical Drawings, wall plates shall be chrome plates cast brass and floor plates shall be nickel bronze. Screws in cleanouts in finished areas shall be vandal-proof.

D. Cleanouts shall be full size at the pipe up to 6" inclusive. On larger size piping 6 inch size plugs shall be used.

E. The following list indicates the various types of cleanout desired at various locations indicated on the Drawings. These cleanouts have been selected from the catalog of Zurn and are representative of quality design and finish desired. Cleanouts of Josam Mfg. Co., or J.R. Smith, or MIFAB, or approved equal may be submitted provided they meet fully in every respect (such as material, weight, clamping features, finish, etc.). The characteristics and quality of the cleanout shall be as follows.

1. Cleanout fitting in vertical stacks shall consist of tapped tees, capable of receiving a rough brass raised head cleanout plug; Zurn 1460-8 or MIFAB #C-1400S-9.
2. Cleanouts in Mechanical Equipment Room shall be Zurn 1420-25 or MIFAB #C1100 XR-4-Z.
3. Cleanouts in finished areas shall be Zurn Z-1420-3 or Z-1400HD or MIFAB #C1100 TS-1 with recess for tile floors.

4. Cleanouts in Dex-O-Tex waterproof floors shall be Zurn No. Z-1405-18 or MIFAB #C1100XR-4-Z with extra heavy duty top.
5. Cleanouts for 3 or more fixtures piped horizontally shall be extended to wall cleanouts, and shall be Zurn No. Z-1470 or MIFAB #C1430.

F. All cleanout plugs shall be brass and lubricated with graphite before installation.

G. Cleanouts will not be allowed to be located in inaccessible locations.

2.14 DRIP PANS

A. In so far as possible, piping shall not be installed within the ceiling or exposed in operating and delivery rooms, nurseries, food preparation centers, food serving facilities, food storage areas, central services, electronic data processing areas, electric closets, and other sensitive areas.

B. When overhead piping in these areas in unavoidable, provide aluminum drip pans with indirect waste extended and spilled to a safe place.

PART 3 - EXECUTION

3.1 GENERAL

A. Testing: Test in accordance with the applicable Plumbing Code.

B. Connections to Equipment Furnished Under Other Sections:

1. Make final connections to all equipment shown on drawings as connected to supply and/or drain piping.
2. Furnish all devices necessary for final connection, including:
   a. Tail pieces
   b. Stops
   c. Supplies

C. Corrosion Protection:

1. Provide isolation between concrete or mortar and any copper pipe.
2. All below grade piping shall be adequately protected from corrosion.

D. Comply with Section 22 05 29 Pipe Supports and Anchors for pipe support requirements.

3.2 INSTALLATION OF DOMESTIC WATER PIPING AND PRODUCTS

A. Install all horizontal water piping level and parallel to building construction (except piping noted to be drained down slope toward drain at 1/8” /ft. min.). Make any changes in direction with fittings, don’t kink or bend. All vertical piping to be plumb. Provide dielectric isolation between uninsulated pipe and hangers. Provide plastic grommets when going through metal studs. Tape is not acceptable for dielectric isolation.

B. Drain Down Provisions (Open Stadiums):

1. Piping throughout building is to be drainable. Slope piping to hose bib to allow complete drain down. Provide isolation valves and additional hose bibbs as required to allow for drain down.
2. Contractor to provide drain down service during construction. First session drain down after construction to be supervised by Plumbing Contractor. Provide instruction for drain down process to be performed by maintenance staff in following years.
3. Include written procedures and diagrams in Operation and Maintenance Manuals.
4. Provide drain down valves and hose bibs at all system low points, traps and at the base of all risers.

C. Water Hammer Arrestors: Install arresters as shown on the drawings and as described in this specification. At minimum any branch line connected to a flush valve shall have one arrestor.

D. Disinfection:

1. After installation of all fixtures served, fill all domestic water lines with a chlorine-water solution of 50 parts per million minimum.
2. Hold solution in pipe for at least 24 hours.
3. Open and close all valves 3 times during chlorination.
4. Waste chlorine solution from each outlet.
5. Measure solution at end. If not 10 ppm, repeat.

E. It is the intent that each part of the plumbing systems shall be complete in all details and all lines provided with all control valves as indicated on Drawings, or as may be required for the proper control of the pipe lines under this Section so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the building.

F. The Contractor shall examine carefully the architectural plans and details and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings. In no case shall the Contractor permit his pipes to be exposed beyond finished plaster lines unless specifically shown on Drawings. He shall consult with the other trades in the building and install his piping in such a way as to least interfere with the installation of other trades. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces.

G. The water piping shall all be installed so as to drain, and branches shall not be trapped, but shall have continuous pitch. Where necessary to raise or lower mains, the same shall be provided with a drip and shall be properly valved and capped.

H. Piping shall be installed, whether indicated or not, so as to rise and/or drop to clear any and all conduits larger than 1", lighting fixtures, ductwork and heating mains, to maintain the desired clear heights. The Contractor shall consult with the other trades and facilitate the erection of the equipment and piping.

I. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

J. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

K. No piping or work shall be concealed or insulated until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

L. Expansion loops and anchors shall be provided on all hot water and hot water circulation mains. Expansion loops shall be made with four elbows and three lengths of pipe, except as otherwise noted on the drawings. All loops shall be prestressed.

3.3 INSTALLATION OF SANITARY AND VENT PIPING

A. Couplings: Apply standard and heavy duty couplings as specified.

B. Gaskets: Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

D. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of the day or whenever work stops.

E. Test Plugs:

1. Provide test plugs in floor drains and roof drains at the time of installation.
2. Leave test plugs in place for the duration of construction until sewer or drainage system is complete.

F. Expansion:

1. Provide a vertical expansion joint at each connection to roof drain unless an offset is provided.
2. Where piping crosses building expansion joints, provide expansion joints to allow for building movement.
3. Refer to Section 22 30 00 for additional requirements.

G. Vent Flashing:

1. Provide 4 lb. sheet lead (24" x 24" minimum).
2. Extend lead 5" above the vent and turned down into vent pipe.

H. Vent Location: Do not install vents within 2 ft. of roof edge, parapet, wall line, or an "on-the-roof structure" and within 10 ft. of any air intake.

.

I. Do not support interior grease, sand or oil interceptors from floor extension. Provide supplemental support structure.

J. The size of storm, soil, waste, water, and vent piping shall be as determined by the local rules and regulations for plumbing and drainage, except where specifically noted to be larger by the

Specifications or plans; and all fixed rules of installation as set forth in the Rules and Regulations shall be followed as part of the Specifications.

K. The Contractor shall examine carefully the architectural plans and details and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings. In no case shall the Contractor permit his pipes to be exposed beyond finished plaster lines unless specifically shown on Drawings. He shall consult with the other trades in the building and install his piping in such a way as to least interfere with the installation of other trades. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces, etc.

L. Branch connections of the drainage systems shall be made with "Wye" and long "Tee-Wye" fittings, short 1/4" bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only.

M. Piping shall be installed, whether indicated or not, so as to clear any and all conduits, lighting fixtures, ductwork and heating mains, to maintain the desired clear heights. The Contractor shall consult with the other trades and facilitate the erection of the equipment and piping. Gravity systems shall have priority.

N. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

O. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

P. No piping or work shall be concealed or insulated until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

Q. Cleanouts shall be provided at foot of all stacks, all changes of directions, at the ends of branch runs where shown, every 50'-0" and as required by Code, and shall be terminated as described under cleanouts.

R. The house drains must be run at a minimum grade of 1/8" per foot downward in the direction of flow. Wherever possible, a 1/4" per foot pitch shall be maintained. Branch connections to stacks from fixtures shall pitch 1/4" per foot where possible. Attention is again called to the necessity of maintaining the ceiling heights established. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces, etc.

S. Furnish and install complete systems of ventilating pipes from the various plumbing fixtures and other equipment to which drainage connections are made. Ventilating pipes shall be connected to the discharge of each trap and shall be carried individually to point 6” above the ultimate overflow level of the fixture before connecting with any other vent pipe; in general, this will be approximately 3'-6" above the finished floor. Branches shall be arranged to pitch back to fixtures.

T. The individual vent pipes shall be collected together in branch vent lines and connected to vent stacks, in general paralleling soil and waste stacks. Wherever possible, vent stack offsets shall be made with 45 degree fittings. The heels of vent stacks shall be connected to adjacent soil stacks for purpose of draining condensation where possible. The waste of a fixture shall be

connected to the base of each vent stack for the purpose of washing out any scales or dirt which may accumulate, or the soil stack shall be used to wash out the heel of the vent.

U. The tops of all soil and waste stacks shall be extended as additional ventilating pipes. The tops of all ventilating stacks shall run independently through the roof. Pipes smaller than 4" size shall be increased to 4" by means of approved increasers before passing through the roof slab.

V. Vent piping sized less than 1½" will not be allowed, even if shown on the drawings or permitted by Code.

W. All open vent pipes that extend through a roof shall be terminated at least 24 inches above the roof, except that where a roof is to be used for any purpose other than weather protection or maintenance, the vent extension shall be run at least 7 feet above the roof.

3.4 INSTALLATION OF STORM DRAINAGE PIPING (ABOVE GROUND WITHIN BUILDING)

A. Couplings: Use heavy-duty couplings on all no hub storm piping above grade. Do not use no hub couplings on piping more than 20 feet below the drain fixture unless offsets are made down through buildings in no more than 20 feet increments. Utilize galvanized steel pipe with screwed or grooved mechanical fittings.

B. Gaskets: Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

D. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of uncompleted pipe at the end of the day or whenever work stops.

E. Test Plugs:

1. Provide test plugs in floor drains and roof drains at the time of installation.
2. Leave test plugs in place for the duration of construction.

F. Roof Drains:

1. Install drains on the center line of roofing reinforcement.
2. Clamp flashing into drain flashing collar.
3. Install domes immediately after completion of roof installation.

G. Expansion:

1. Provide a vertical expansion joint at each connection to roof drain unless an offset is provided.
2. Where piping crosses building expansion joints, provide expansion joints to allow for building movement.

3. Refer to Section 22 30 00 for additional requirements.

H. Downspout Nozzles: Install with flange secured to wall at base of concealed storm leaders that discharge through the building wall above grade.

I. Cleanouts shall be provided at foot of all stacks, all changes of directions, at the ends of branch runs where shown, every 50'-0" and as required by Code, and shall be terminated as described under cleanouts.

J. The house drains must be run at a minimum grade of 1/8" per foot downward in the direction of flow. Wherever possible, a 1/4" per foot pitch shall be maintained. Branch connections to stacks from fixtures shall pitch 1/4" per foot where possible. Attention is again called to the necessity of maintaining the ceiling heights established. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces, etc.

K. Piping shall be installed, whether indicated or not, so as to clear any and all conduits, lighting fixtures, ductwork and heating mains, to maintain the desired clear heights. The Contractor shall consult with the other trades and facilitate the erection of the equipment and piping. Gravity piping shall have priority.

L. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

M. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

N. No piping or work shall be concealed or insulated until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

O. Branch connections of the drainage systems shall be made with "Wye" and long "Tee-Wye" fittings, short 1/4" bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only.

P. Connection to roof drain shall be installed in conjunction with the roofing called for under another Division or Section of these Specifications and at such times as designated by this Contractor, so that the building is adequately protected during construction from damage by storm water. All piping shall be adequately and properly supported, and all joints shall be made up as hereinafter specified.

3.5 TRAP PRIMERS

A. Install all trap primers and required distribution units as shown on plans and as required by manufacturers recommendations.

END OF SECTION 221000

SECTION 221100 - SAFETY EYEWASHES

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 22 40 00 for Products

1.2 GENERAL REQUIREMENTS

A. Installations must meet the following Codes and Standards:

1. ANSI/ISEA Standard Z358.1 - 2009, American National Standard for Emergency Eyewash and Shower Equipment.
2. NFPA 70, National Electrical Code (NEC)
3. Building Codes of New York State
4. Occupational Safety and Health Administration (OSHA)
5. ICC/ANSI Standard A117.1 – Accessible and Usable Buildings and Facilities

1.3 DEFINITIONS

A. The following definitions are included in the ANSI Z358.1 Standard:

1. Combination Unit: An interconnected assembly of emergency equipment supplied by a single source of flushing fluid.
2. Drench Hose: A supplemental device consisting of a flexible hose connected to a flushing fluid supply and used to provide fluid to irrigate and flush face and body areas.
3. Eye/Face Wash Equipment: A device used to provide fluid to irrigate and flush both the face and the eyes simultaneously.
4. Eyewash: A device used to provide fluid to irrigate and flush the eyes.
5. Flushing fluid: Potable water, preserved water, preserved buffered saline solution or other medically acceptable solution manufactured and labeled in accordance with applicable government regulations.
6. Personal Wash: A supplementary device that supports plumbed and/or self-contained units, by delivering immediate flushing fluid to the eyes or body.

1.4 PLUMBING CONNECTIONS

A. All new installations must be supplied with tempered water. Tempered water is anywhere between 60°F and 100°F, with the ideal temperature being set at 85°F.

B. Domestic cold and hot water lines to eyewashes will be insulated. Provide PVC jacketing on exposed piping subject to damage.

C. Strainers are r e q u i r e d in the hot and cold water lines ahead of tempering

valves and eyewashes, or showers.

PART 2 - PRODUCTS

2.1 PREFERRED MANUFACTURERS

A. Emergency Eyewashes:

1. Bradley
2. Encon
3. Watersaver

B. Thermostatic Mixing Valves:

1. Bradley
2. Encon
3. Lawler

2.2 EMERGENCY EYEWASHES

A. A plumbed eyewash is required in a workplace wherever persons are subject to exposure to concentrated corrosives (acids and bases), cleaners, disinfectants, or other chemicals or substances that could be injurious to the eyes. During renovations, existing emergency eyewashes must be upgraded to meet current standards.

B. Allowable Devices:

1. Sink mounted, swing-a-way eyewashes, free standing eyewashes, and combination emergency shower/eyewash units are preferred in lab applications.
2. Faucet mounted eyewashes are not acceptable devices for new installations or renovations.
3. If drench hoses are required by the program, they must meet the performance requirements of an eyewash.
4. Hand held eyewash bottles are considered as supplemental equipment and will not be accepted as the sole means of an eyewash installation within a workspace. The use of these devices must be approved by EH&S and Facilities Engineering on a case by case basis.

C. Emergency eyewashes and eye/face washes shall meet the following requirements:

1. Constructed of stainless steel or high impact plastic.
2. The eyewash equipment must deliver a minimum of 0.4 gallons per minute for

15 minutes.

3. For standard freestanding eyewashes, the nozzles should be positioned between 33 and 45-inches above the finished floor, and for ADA eyewashes, the nozzles should be positioned between 33 and 36-inches above the finished floor. A minimum of 6-inches shall be provided from the wall or nearest obstruction. The nozzles must be easily accessible to the operator with no obstructions.
4. The eyewash must be installed with sufficient space to allow the user to hold their eyelids open with both hands while the eyes are being rinsed.
5. Nozzles shall be protected from airborne contaminants with caps.
6. The spray pattern of eyewash and eye/face wash equipment shall conform to the relevant section in the ANSI Standard using an eyewash test gauge.

END OF SECTION 221100

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 **SUBMITTALS**

A. Submit manufacturer's product data for the following:

1. Warranty and service policies.
2. Escutcheons.
3. Traps.
4. Thermostatic mixing valve.
5. Unions.
6. Hose Bibbs.
7. Thermometers.
8. Pressure Gauges.
9. Vacuum Breakers.
10. Drains.

PART 2 - PRODUCTS

2.3 **PIPE EXPANSION COMPENSATORS**

A. Any breaks or damage to the piping system or to the Work of other Sections within the period of the guarantee due to improper provision for expansion and contraction must be replaced at this Contractor's expense.

B. This Contractor is to provide for expansion of pipes by providing expansion compensators and/or expansion loops and shall provide anchors at pump discharge and suction line. All expansion loops shall be pre-stressed.

C. Make adequate provisions for proper expansion and contraction of piping. At connections of branches to water mains, risers and at connections to heaters, coolers and other equipment, provide sufficient number of elbow swings to allow for proper expansion and contraction of piping. Provide adequate elbow swings, expansion compensators, expansion loops or approved type extension joints, wherever noted, indicated, or required to allow for proper expansion and contraction of mains and risers.

D. This Contractor shall provide, where necessary to absorb expansion and contraction in hot water recirculation, pipe lines (except at building expansion joints) 3 inches and smaller and for system pressure less than 50 psi, Flexonics Model HP expansion compensators having two-ply phosphor bronze elbows and brass shrouds and end fittings, as manufactured by U.O.P. Flexonics Division, Bartlett, Illinois. All internal parts shall be of non-ferrous metals. Service pressure shall be external to the bellows. Compensators shall have integral guides extending the full length of the bellows travel. Compensators shall have external positive anti-torque devices to prevent twist.

E. This Contractor shall provide as shown on the plans and/or where necessary to absorb expansion and contraction in hot, hot water recirculation and larger and for system pressures

exceeding 50 psi, Flexonics controlled-flexing expansion joints as manufactured by U.O.P. Flexonics Division, Bartlett, Illinois, or approved equal, with plate steel flanges having ANSI drilling, pipe nipple ends beveled for welding, by hydraulically formed from a stainless steel reinforcing neck ring and control rings shall be of a design to limit movement of each corrugation, as well as to carry hoop stresses caused by internal pressures. Where required, the bellows shall be annealed and/or stress relieved. Before assembly, the corrugated bellows must be pickled to remove all scale formed by annealing and passivated to provide that maximum corrosion resistance.

F. All lines in which expansion joints are installed must be securely anchored and guided in accordance with Manufacturer's recommendations.

G. Provide expansion loops/joints in all hot water and hot water circulating piping which exceeds 145 feet developed length, horizontally or vertically without offsets, and as indicated on the drawings.

2.4 ESCUTCHEONS

A. This Contractor shall provide escutcheons on all exposed pipe wherever they pass through floors, ceilings, walls or partitions.

B. Escutcheons for pipes passing through outside walls shall be Ritter Pattern and Casting Co., No. 1, solid, cast brass, flat type secured to pipe with set screws.

C. Escutcheons for pipes passing through floors shall be Ritter Pattern and Casting Co., No. 36A, split hinged, cast brass chromium plated type.

D. Escutcheons for pipes in unfinished areas shall be cast iron, secured with set screws.

2.5 TRAPS

A. Each fixture and piece of equipment requiring connection to the drainage system shall be separately trapped by means of a water seal trap placed as close to the fixture as possible.

B. All running traps on drains, etc., shall have inlet handhold cleanouts and brass plug cleanouts in bottom. Cast iron trap in ground shall have bottom plug omitted. All exposed P traps shall have bottom cleanouts and shall be chromium plated brass.

2.6 THERMOSTATIC MIXING VALVE

A. Lavatory/Hand Sinks: Temperature Limiting Devices: Leonard Model 170-LF (3/8”). Valve shall be listed to ASSE 1070 and 3rd party approved as lead free. Valve shall be rated to 125 psig, 3/8” inlets/outlet (170-LF), 0.25 GPM minimum flow and a maximum of 2.7 GPM flow capacity at 15 psi system pressure drop. Valve to include locking temperature regulator and integral hot and cold supply checks. Valve options maybe include a dial thermometer, ball valve on the outlet, chrome plated (-CP) finish. Bi-metal thermostat shall be warrantied for a minimum of 10 years.

B. Emergency Mixing Valves: Leonard Model TA-300-LF-CP**.** Valve shall be listed to ASSE 1071 and 3rd party approved as lead free. Valve to have an internal cold water bypass of 4 GPM and provide 6.5 GPM flow capacity at 30 psi pressure drop. Valve to be of rough bronze

construction, or if installed a non-mechanical room environment, the valve shall be chrome plated. Valve shall be rated to 125 psig, 1/2” inlets/outlet, color-coded outlet dial thermometer, hot and cold supply check stops, and wall mounting bracket. Valve shall be factory pre-assembled and tested. Bi-metal thermostat shall be warrantied for a minimum of 10 years.

2.7 UNIONS

A. Where required: On inlet and outlet of all apparatus and equipment having connections 2" and smaller. Where valves are adjacent to equipment unions shall be on downstream side of valves.

B. Type:

1. Steel piping: Malleable iron, WOG female pattern, brass seat, ground joint, 300 lb.
2. Copper tubing: Ground joint, 150 lb. WOG pattern.
3. For piping over 2" flanged joints to be used.

C. Gaskets shall be 1/16" thick similar to Garlock or Cranite factory cut, one piece.

2.8 HOSE BIBBS

A. Hose bibbs shall be Chicago Faucets #952, MIFAB #HY-9241, or approved equal, with vacuum breaker and loose key except as specified herein. Combination hot and cold hose bibbs shall be Chicago #305-VBC.P., MIFAB #HY-8500, or approved equal; modify for piped mounting less loose flange.

2.9 THERMOMETERS

A. Thermometers shall be the adjustable angle, red reading mercury type with 7" black baked enamel case, black on white scale, range from 30˚F. to 240˚F., and separable brass socket. Thermometers shall be so installed and adjusted that they are easily readable from a normal standing position on the floor, U.S. Gauge "Multi-angle".

2.10 PRESSURE GAUGES

A. Pressure gauge shall have 3-1/2" diameter black enamel cast aluminum case threaded brass ring with heavy glass, phosphor bronze bushed rotary precision movement and dial range of 0 to 200 psi for water service; Trerice Co. No. 500X or approved equal, with brass tee handle cock.

2.11 DRAINS

A. Drains shall have heavy cast iron, with double drainage flange and weep holes, with outlet connections as indicated and of sizes indicated on Drawings. Drains (except as noted) shall be furnished with high polished brass tops consisting of one-piece rim secured to the body and vandalproof spanner type screws, solid brass grate with reinforcing members on underside. Removable sediment basket shall be of heavy duty one-piece construction as specified hereinafter. All strainers or grates shall be secured with vandalproof spanner type screws, unless otherwise specified.

B. All drains in membrane waterproof floor shall be equipped with 6 lb. lead flashing or 20 oz. soft

rolled sheet copper and secured to the flashing flange with brass bolts and cast iron clamping device. Flashings shall bond not less than 1'-0" on all sides into membrane waterproofing.

C. On roofs, furnish and set, in conjunction with the roofer, and when directed by the General Construction Contractor, approved roof drains of cast iron unless otherwise indicated.

D. Flashing of 6 lb. or 20 oz. soft rolled sheet copper 34" x 34" shall be furnished and installed at each roof drain by means of non-puncturing type flashing clamping device.

E. Set all drains in such a way that the floor finish and top of the drain will be plumb and flush with finish floor without requirements for future additional extension, modifications, etc.

F. When Dex-O-Tex and/or vinyl waterproof floor is indicated on the Architectural Drawings, all drains must be provided with required flanges.

G. Provide trap primers in all locations where a hose bib is not shown within 10’ of a drain.

H. All drains, except as noted, shall be similar to or equal to Zurn, J.R. Smith, Josam, Wade or Ancon and shall be as follows:

1. Roof Drains R.D. Type A - Similar and equal to no. Z-100-ERC or MIFAB #R 1200 BUV dura-coated cast iron body with combination flashing collar and gravel stop, cast iron dome, underdeck clamp and sump receiver and perforated extension collar to accommodate roof insulation. Drain must be applicable for each roof construction.

2. Floor Drains F.D. Type A (Mechanical and Concealed Equipment Rooms) - Similar and equal to No. Z-505 or MIFAB #F1340-Y-14-4-F-50 Funnel cast iron body and flashing collar with cast iron tractor grate and flat bottom strainer. No. Z-414 cast iron funnel attached to grate, where indicated on the Drawings.

3. Floor drains F.D. Type B (Bathrooms, Finished Area, Shower, etc) - Similar and equal to No. ZN-415-B cast iron body, flashing collar, square nickel bronze top and ZN-414 funnel or MIFAB #F1100 C S5-1 F – 4 -1 funnel attached to grate where indicated on the Drawings.

4. Floor Drains:

   a. Refer to Architectural drawings for exact locations and additional installation requirements.
   b. Install floor drains with P-traps and vent as required.
   c. Install drains on the center line of sheet lead pan and/or membrane in waterproofed areas and in floors above lowest floor.
   d. Clamp pan and/or membrane into drain flashing collar.
   e. Install strainers immediately after completion of finish floor installation.
   f. Coordinate locations with mechanical equipment.
   g. Install trap primers at all drains where a hose bib is not shown within 10’ of drain.
   h. Provide extra heavy duty grates/strainers in locations subject to vehicular traffic.

PART 3 - EXECUTION

3.1 DRAINS

A. Contractor shall protect drains immediately upon installation. Drain grates shall be covered throughout construction to prevent construction debris from entering the drainage system.

B. Contractor shall test all drains just prior to turnover to confirm all drains, traps and pipes are clear and draining properly.

C. Drains, traps and pipes that are found to be clogged upon testing shall be cleaned and/or replaced, water jetted and scoped by a camera immediately, at no additional cost to the owner.

D. The contractor shall be responsible for a set period of time after project completion to clean drains, traps and pipes that do not appear clogged upon testing.

END OF SECTION 223000

SECTION 22400 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for plumbing fixtures and accessories, in accordance with Division 1.

PART 2 - PRODUCTS

2.1 GENERAL

A. All manufacturers are listed in alphabetical order and not by preference.

B. Provide factory fabricated fixtures.

C. Provide trim, carriers, valves and accessories as required for complete installation. All carriers are floor mounted unless otherwise noted. All carriers shall be bolted down to floor structure.

D. Comply with Local, State and Governing ordinances concerning maximum water requirements of plumbing fixtures: Tank type W.C. and flush valve type for Water closets 1.28 gal./flush; lavatories = 0.5 GPM; urinals = 0.05- 0.5 gal./flush; sinks = 2.2 GPM; and showers = 2.0 GPM. Fixture performance shall be better than code limits where specified fixture offers improved performance.

E. All fixtures used for potable water service should be compliant with NSF-61. Provide fixtures which meet or exceed standards of the Federal Reduction of Lead in Drinking Water Act, Safe Drinking Water Act and Lead Contamination Control Act, NSF Standard 61, Section 9. All components in the waterway to be lead free.

F. See Architectural Drawings for fixture requirements. Fixtures specified in this plumbing specification shall be provided only if a suitable fixture is not specified in the architectural drawings or specifications.

2.2 PLUMBING FIXTURES

A. Refer to Architectural drawings for design basis of all plumbing fixtures.

B. All fixture trimmings, including faucets, strainers, escutcheons, shower head and arm, water closet supplies, stops, waste trap, escutcheons, visible hanger or chair carrier nuts shall be made of brass and shall be polished chromium plated. All material to be specified as chromium plated and shall be thoroughly and evenly applied and guaranteed not to strip or peel. All chromium plating on plumbing fixture trim shall be in accordance with Federal Spec. WW-P-54lb for grade "R" plating. Manufacturer shall submit certification that all chrome plating on finished trim meets aforementioned Federal Specification. All plated work shall be highly buffed. Plastic, zinc or white metal will not be approved.

C. All fixtures shall be free from imperfections, true as to line, angles, curves and color, smooth,

watertight, nameplate in every respect and practically noiseless in operation. Fixtures as specified are given as a typical standard and they or other approved fixtures shall be furnished, set and connected in good substantial, neat and workmanlike manner.

D. All fixtures, specified to be vitreous ware, shall be fixed vitreous china ware of the best quality, non-absorbent and burned so that the whole mass is thoroughly fused and vitrified, producing a material white in color which, when fractured, will show a homogenous mass, close grained and free from pores. The glazing and vitreous china fixtures shall be white, thoroughly fused and united to the body, without discoloration, chips, or flaws, and shall be free from craze. Warped or otherwise imperfect fixture will not be acceptable.

E. Each supply fixture, casework fixture and equipment, shall be separately controlled by its own stops. Locate as required on wall, above floor or as directed.

F. All faucets shall have metal handles.

G. All trim shall be permanently stamped with manufacturer's identification and visible after installation.

H. All fixtures, faucets, flush valves, etc., are to be ADA compliant, unless specifically noted otherwise.

2.3 WATER CLOSETS

A. Design Basis: As scheduled

B. Flush Valves: As scheduled

C. Water closet shall be vitreous china water saver with elongated bowl.

D. Flush handle (flushing mechanism) shall be located on “wide side” of ADA access.

E. Combination water closet carriers and drainage fittings shall be Zurn Z-1203 and 1204 Series, MIFAB MC -10 L /R or MC -13 R/L, or approved equal with feet bolted to construction.

2.4 WATER CLOSET SEATS

A. General Construction: Unless otherwise specified seats shall be heavy duty solid plastic, have molded-in bumpers, concealed self-sustaining check hinge with stainless steel posts and pintles. Seat shall have an antimicrobial compound as an integral part of the plastic and shall match shape of bowl (elongated or regular).

2.4 P-3 LAVATORIES

A. Design Basis: As scheduled

B. Faucet: As scheduled

C. Unless otherwise specified, all lavatories are white.

D. Provide offset P traps on all ADA lavatory installations similar to American Standard 7723.018 grid strainer, polished chrome finish.

E. McGuire Mfg. TPC20FR (Pair) 1/4" offset threaded tailpieces.

F. McGuire Mfg. LF165LK (Pair) 3/8" SPS wall supplies with loose key stops with McGuire Manuf. 127038 cast brass set screw escutcheons.

G. McGuire Mfg. 8902C, 1-1/4" x 1-1/2" chrome plated cast brass "P" trap with cleanout plug.

H. McGuire Mfg. 2127C, 1-1/2" SPS chrome plated brass trap nipple and cast brass set screw escutcheon.

I. Supported on Zurn ZX-1231 or MIFAB MC – 41 (250 - lbs - load) concealed chair carrier with concealed arms and block feet bolted into construction.

J. All exposed piping serving plumbing fixtures that may be used for ADA purposes shall have traps and supplies insulated per ADA requirements.

2.5 MOP SINK BASIN

A. Design Basis: As scheduled

B. Faucet: A scheduled

C. All mop sinks faucets shall have a vacuum breaker an integral check valves.

D. Faucet shall be chrome plated with pail hook and wall brace.

E. Drain: Stainless steel, flat strainer, 3” IPS.

2.6 STAINLESS STEEL SINKS

A. Design Basis: As scheduled

B. Faucet: A scheduled

C. Mounting: Countertop, self-rimming.

D. Sink shall be a minimum of 18 gauge, type 304 stainless steel.

E. Trap: 1½” adjustable, cast brass.

F. Stops: Loose key, ½” FPT, flexible supply, flange.

G. Provide chrome plated brass tailpiece and grid strainer.

2.7 EYE WASH

A. Faucet: A scheduled

B. Eyewash, wall mounted, stainless steel bowl and skirt.

C. Mixing valve.

D. McGuire Mfg. LF167 Pair 167 stop and supplies.

E. Brass set screw escutcheon.

F. Eyewash Bowl Accessories

1. Sink strainer PP-41A.
2. Tailpiece
3. Deep seal P-trap and P-trap outlet piece.

2.8 SERVICE SINK

A. Fixture: A scheduled

B. Faucet: A scheduled

C. American Standard. 7798.030 - 3" "P" trap with strainer.

D. Rigid water supplies with stops.

2.9 EQUIPMENT FURNISHED UNDER OTHER SECTIONS

A. Provide all materials necessary to make final connections to equipment furnished under other Sections of these Specifications including:

1. Tail pieces
2. Stops
3. Supplies
4. P traps, standard and/or offset
5. Escutcheons

B. All fixture trimmings, including faucets, strainers, escutcheons, shower head and arm, water closet supplies, stops, waste trap, escutcheons, visible hanger or chair carrier nuts shall be made of brass and shall be polished chromium plated. All material to be specified as chromium plated and shall be thoroughly and evenly applied and guaranteed not to strip or peel. All chromium plating on plumbing fixture trim shall be in accordance with Federal Spec. WW-P-54lb for grade “R” plating. Manufacturer shall submit certification that all chrome plating on finished trim meets aforementioned Federal Specification. All plated work shall be highly buffed. Plastic, zinc or white metal will not be approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install each fixture with P trap with cleanout plug, easily removable for servicing and cleaning.

B. Provide chrome plated, rigid supplies to fixtures with stops, reducers and escutcheons. Flexible supplies will not be permitted.

C. Finish wall and floor penetrations when exposed to view in finished areas with set screw type, chrome plated brass escutcheons.

D. Set plumbing fixtures level and plumb, spaced in accordance with architectural dimensioned drawings, and securely install to be rigid. Install wall mounted lavatories, urinals and water closets with wall carriers mounted to the floor. Solidly attach floor mounted carriers for all fixture to floor using proper fasteners based on floor construction. Securely anchor flush valves behind or within walls to be rigid and not subject to movement due to push or pull action on the valve.

E. Cover fixture bolts with china bolt caps of the same color where required.

F. All wall mounted fixtures to be caulked between fixture and wall.

G. Refer to Architectural drawings and ADA standards for fixture mounting heights.

H. The Contractor shall make all plumbing connections to all equipment and fixtures requiring such connections as shown on Drawings whether the equipment and fixtures are furnished under this Section or other Divisions or Sections. Investigate the equipment furnished under other Divisions or Sections to determine if combination fittings have a means of shutoff or required the installation of check valves, backflow preventors and/or pressure reducing valves. Make final connections to such, including installations of all special traps, supplies, control valves, etc. furnished with such equipment, and furnish all material necessary that is not supplied with the equipment.

I. The Contractor shall leave valved water connections in equipment spaces and other locations where shown for the use of other trades or other Sections. On each valved outlet for equipment with submerged inlets, provide a backflow preventor after the shut-off valve. .

J. Fixture supplies and traps as specified, shall be chrome plated brass, where exposed to view. Where concealed from view in cabinets, etc., they may be rough brass. All fixture supplies shall have stops.

K. As soon as installed, all metal fixture trimming shall be thoroughly covered by this Contractor with noncorrosive grease which shall be maintained until all construction work is completed.

L. Upon completion of the Work, test flush valves and faucets for leaks or drips and adjust same for quiet operation.

M. All fixtures shall be left thoroughly clean. All plated or polished fittings, pipes and appliances shall be coated with non corrosive grease, immediately after installation, and shall be finally

polished and free from all marks and foreign substances.

N. Equipment and all connections shall be in accordance with the rules relative to submerged inlets, and shall be provided with all necessary vacuum breakers and check valves, in accordance with the applicable codes.

O. Connection between any fixture with a floor outlet and the flange shall be made with an approved prepared gasket that shall be a germicide, absolutely gas and fumeproof, watertight, stain-proof, containing neither oil nor asphaltum, and which will not rot, harden or dry under any extreme of climate change, and must adhere on wet surfaces.

P. Each fixture shall be separately trapped, using the type and size of trap called for specifically in the Specifications, or the type required by the Plumbing Code. The traps shall be approved type.

Q. All fixtures requiring hot and cold water shall have the cold water faucet on the right hand side of the fixture and the hot water faucet on the left hand side of fixture.

R. The Contractor shall be responsible for protecting against injury from the building materials, acids, tools and equipment, all plumbing fixtures equipment, etc., provided under Plumbing Work Sections.

S. No slip joints will be permitted on water piping.

T. Double compartment sinks or lavatories shall be provided with faucet, trap, supplies, etc., for each compartment.

U. Funnel drains and/or floor drains shall be provided for the air conditioning, heating and refrigeration work as required.

3.2 CLEANING AND ADJUSTING

A. Cleaning:

1. Clean strainers, traps, aerators, and valves of debris, sand and dirt.
2. At completion, thoroughly clean plumbing fixtures and equipment.
3. All fixtures shall be left thoroughly clean. All plated or polished fittings, pipes and appliances shall be coated with Vaseline, immediately after installation, and shall be finally polished and free from all marks and foreign substances.

B. Adjusting:

1. After cleaning and flushing operations are accomplished, adjust flush valves, faucets, showers, bubblers for proper flow.

3.3 PROTECTION

A. Protect fixtures and related components from damage before, during, and after installation to date of Final Acceptance or Owner move-in. Provide protective coverings or other protection as required.

B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect or Engineer.

C. Remove cracked or dented units and replace with new units.

D. Contractor shall be responsible for replacing damaged fixtures or components.

3.4 SERVICES TO FIXTURES AND EQUIPMENT FURNISHED UNDER OTHER SECTIONS

A. The list of equipment for the project shall be reviewed by this Contractor, who shall include in the Contract price the costs for installing all equipment as herein specified and as claimed by the Trade Unions as Plumbing Work.

B. Refer to Architectural and Plumbing Drawings for exact locations of equipment and fixtures. Provide all materials, equipment and appliances necessary and required to complete the installation of all Hospital casework and equipment, including but not limited to the following: plumbing, roughing and final connections, valves, stops, trim, escutcheons, fittings, traps, etc. Install faucets, trim, etc., furnished with the equipment provided by others.

C. Unless otherwise detailed on Drawings, roughing of proper size and capacity for equipment indicated on Architectural, Heating and Ventilation, Plumbing or Electrical Drawings or provided under another Division or Section shall be provided and installed in such a manner and location that final connection can be made with a minimum of work and without cutting patching permanent walls, partitions, ceilings or floors. Drawings are of necessity, schematic, for special equipment as exact roughing and requirements may vary with different manufacturers.

END OF SECTION 224000

SECTION 225522 - ELECTRIC HEATING CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions and Division 26 Materials and Methods, Grounding, and Wires and Cables.

1.2 SUMMARY

A. Furnish and install all electric heating cable systems as specified herein and as required for freeze protection, and heating of piping, valves, fittings, drains, etc., as indicated on the Drawings. Division of work shall be as follows:
   1. Plumbing and HVAC Contractors shall provide the heating cables, cable connection components (power connections, tee's and splices) and power distribution panels with alarm breakers, and ground fault protection.
   2. The Electrical Contractor (EC) shall receive the power distribution panels and heating cables from the plumbing Contractor and install and provide power wiring to the heat trace cables. In addition, the EC shall:
      a. Furnish and install all power wiring, circuit breakers and J-boxes necessary for connection to the Electric Heating Cable assembly. The circuit breakers shall be of the GLCB ground fault protection type designed to trip if current imbalance exceed 30 mlliamps, similar to Square D QO-EPD or Westinghouse GFEPD.
      b. Cooperate with the plumbing contractor to coordinate the installation and testing of the system. Electrical connections and testing shall be performed by licensed electrician, including all cable splices, tee's and power connections.
      c. Provide as-built diagrams of the tracing installation, type and temperature of cable, locations of the junction boxes and circuit identification of breakers.
   3. The Temperature Controls Contractor shall provide and install low voltage wiring to the BMS system and assign alarm points for each panel.

1.3 REFERENCE STANDARDS

A. Each electric heating cable system and all components shall be designed, manufactured and tested in accordance with the latest applicable UL, NEMA, and ANSI Standards as well as NFPA 70 - National Electrical Code (NEC) UL508A, with City of New York Amendments.

B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed and bear an MEA listing as necessary for the City of New York in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the General Conditions and shall include, but not be limited to:
   1. Electric Heat Tracing System including cables, fittings, thermostats, installation details, circuit capacities, operational details, power distribution panel for group control, etc.

A. Submit Shop Drawings for review prior to installation. Shop Drawings shall show the overall system and each circuit, control locations, cable lengths, current required for each circuit and feed points. Provide a summary sheet of the entire system with capacity data for each line, valve, etc. See Section 26 05 02 for Shop Drawing requirements. At minimum, the submittal must provide the following:
   1. Circuit identification number.
   2. Maintain temperature.
   3. Line size and insulation.
   4. Heat loss for pipe, valves, and supports.
   5. Amount and type of heating cable required.
   6. Spiral requirements.
   7. Heating cable service voltage.
   8. Heating cable power output at the maintain temperature.
   9. Uncontrolled pipe temperature at maximum ambient.

B. .

1.5 WARRANTY

A. Comply with the requirements of the General Conditions and Section 26 05 02.

B. Provide with ten (10) years warranty extension.

PART 2 - PRODUCTS

2.1 ELECTRIC HEATING CABLE SYTEM FOR HOT WATER PIPING TEMPERATURE MAINTAINENCE SYSTEM

A. Manufacturers:
   1. Design Basis: Chromalox HWM-CT for hot water temperature maintenance.
   2. Other acceptable manufacturers:
      a. Raychem HWAT
      b. Thermon
      c. Nelson
   3. Manufacturer shall provide installation training and periodic supervisory visits to the site as described under FIELD QUALITY CONTROL.

B. Self-regulating heating cable shall be used for maintaining hot water piping systems for use at temperatures up to a continuous exposure (maintain) of up to140°F

C. The heating cable shall be provided with Fluoropolymer corrosion resistant overjacket.

D. The piping will be insulated as specified in Division 22 in Section titled “Plumbing Insulation”.

E. Heating cables shall be UL listed pair of parallel No. 16 AWG, nickel plated copper bus wires embedded in a continuous core of radiation cross-linked conductive polymer which varies its power output in response to pipe temperature changes. Cable shall be capable of crossing over itself once without overheating.

   1. Electrical Insulating Inner Jacket: Flame-retardant modified polyolefin.

2. Plasticizer diffusion shield.
3. Cable Cover: Thick gauge (5/24) tinned-copper braid for ground path and mechanical ruggedness with color coded nominal 40 mil modified polyolefin outer jacket.
4. The outer jacket of the heating cable shall have the following markings: Heating cable model number; Agency listings; Meter mark; Lot/Batch ID
    1) Maximum Operating Exposure Temperature: 140 deg F

2.2 ACCESSORIES

A. Termination For Self-Regulating Heating Cables - Cable Installation Accessories

1. All connection components used to terminate self-regulating heating cables, including power connectors, splices, tees, and connectors, shall be approved for the respective area classification and approved as a system with the particular type of heating cable in use. Under no circumstances shall terminations be used which are manufactured by a vendor other than the cable manufacture.

    a. Components and enclosures shall be rated NEMA 4X.
    b. All components shall be direct pipe mounted.
    c. All components shall be above insulation style.
    d. No heat shrink style connections shall be used.
    e. All heat trace connections shall utilize terminal blocks.

B. Power Connection, end seal, splice and tee kits components shall be UL Listed and FM Approved, quick connect type rated for 30 AMPS, all components shall have power test points, power connections shall be factory terminated and supplied with 10’ of cold leads. Furnish all power connections, tees, splices, end seals (silicone gel type), fiberglass tape and electric traced labels, as required. Lighted end seals shall be installed for critical end of line power verification where indicated. All components, except the power connections and any lighted end seals, shall be installed under the thermal insulation. All of the above, plus Fiberglass tape shall be furnished by the cable manufacturer.

2.3 THERMAL PIPE INSULATION

A. The piping will be insulated as specified in Division 22 in Section titled “Plumbing Insulation”.

B. Insulate all hot water piping, whether heat traced or not. Do not use staples to secure the insulation. For proper temperature maintenance, insulation must be properly sized, complete and sealed, pipe hangers shall be outside of the insulation.

2.4 CONTROL, MONITORING AND POWER DISTRIBUTION SYSTEMS

A. Design Basis: Chromolox ITC2 – Digital Heat Trace Controller 2 Circuit Model
1. Ground Fault Protection is provided from circuit breaker, a digital line sensing thermostat shall switch power to the heat trace cable. The thermostat shall be equipped as follows:
    a. NEMA 4X enclosure.
    b. Solid State Relay rated 40 Amps.
    c. LED indication for Setpoint, Power, Load & Alarm.
    d. Common alarm contact for Temp, RTD Failure or Loss of Power.
    e. Pipe or wall mounted.

f. UL Listed.
g. Controller to be provided with a temperature sensor, type RTD.

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PART 3 - EXECUTION

3.1 SCOPE AND REQUIREMENTS

A. Furnish and install a complete electric heating cable system, including but not limited to cable, panels, ambient air sensors, aquastats, and controls, on all water piping, fittings, drains, valves, and valve bonnets as indicated on the Drawings. The Electrical Subcontractor shall coordinate the cable installation with the Mechanical and Plumbing Subcontractors. See drawings for scope and locations.

B. All installation and materials furnished shall meet the NEC requirements and be Underwriters Laboratories listed for the application.

C. The installation and all materials, conductors, conduit, etc. utilized between the electric heating cable system, controls and distribution panels shall be as specified.

D. After the piping has been successfully pressure tested, heating cables shall be installed parallel to the pipe or by spiraling the strip to obtain the heating capacity required. All cables and components shall be installed as recommended by the manufacturer by properly trained personnel using the manufacturer specified tools and procedures and as specified herein. The heating cables shall be banded to the pipe with fiberglass tape per manufacturer recommendations. After the piping has been insulated, appropriate caution signs or markings shall be provided at frequent intervals along the pipeline in accordance with NEC requirements.

E. Heat trace cable shall be installed by a licensed electrician. Plumbing contractor shall subcontract this work to a licensed electrician if plumbing contractor is not a licensed electrician.

F. Apply the heat trace cable on the pipe after pressure testing.

1. Do not spiral wrap on pipe.
2. Make one wrap at valves.
3. Secure to pipe with methods approved by manufacturer.

G. Apply “Electrically Traced” signs on outside of insulation.

3.1 ENGINEERING AND DESIGN

A. The vendor shall be given a line list from which to design and estimate a complete heat-tracing system. The bid package shall also include area layout and orthographic drawings.

B. The vendor shall provide a detailed design utilizing standard heat-tracing design software. At minimum, the design must provide the following:
1. Circuit identification number.
2. Maintain temperature.
3. Line size and insulation.
4. Heat loss for pipe, valves, and supports.

5. Amount and type of heating cable required.
6. Spiral requirements.
7. Heating cable service voltage.
8. Heating cable power output at the maintain temperature.
9. Uncontrolled pipe temperature at maximum ambient.

3.2 INSTALLATION

A. All installation and materials furnished shall meet the NEC requirements and be Underwriters Laboratories listed for the application.

B. The installation and all materials, conductors, conduit, etc. utilized between the electric heating cable system, controls and distribution panels shall be as specified.

C. After the piping has been successfully pressure tested, heating cables shall be installed parallel to the pipe or by spiraling the strip to obtain the heating capacity required. All cables and components shall be installed as recommended by the manufacturer by properly trained personnel using the manufacturer specified tools and procedures and as specified herein. The heating cables shall be banded to the pipe with fiberglass tape per manufacturer recommendations. After the piping has been insulated, appropriate caution signs or markings shall be provided at frequent intervals along the pipeline in accordance with NEC requirements.

D. Heat trace cable shall be installed by a licensed electrician. Plumbing contractor shall subcontract this work to a licensed electrician if plumbing contractor is not a licensed electrician.

E. Apply the heat trace cable on the pipe after pressure testing.
1. Do not spiral wrap on pipe.
2. Make one wrap at valves.
3. Secure to pipe with methods approved by manufacturer.

F. Apply “Electrically Traced” signs on outside of insulation.

G. The Electrical Subcontractor shall test all electric heating cable systems for short circuits, grounds and insulation resistance. Test with 1000 VDC to a minimum resistance of 20 mega ohms.

H. Comply with manufacturer’s recommendations in the Installation and Operation Manual. Should the manufacturers requirements differ from the project design, the Contractor shall issue an RFI seeking clarification prior to proceeding with the installation.

I. Prior to installation, heating cables and other material shall be stored in a dry location.

J. Heating Cable must be megger tested according to the specification and values shall be recorded for records by contractor

K. Systems with control panels must be field commissioned by manufacturers representative

L. Contractor shall keep accurate records for true installation lengths and circuits.

M. Sensor (low voltage) and Power Wiring must be ran in separate conduit according to the National Electric Code.

N. Install insulation over piping where electric heat trace is present. Pipes must be thermally insulated in accordance with Insulation specifications. Insulate all hot water piping, whether heat traced or not. Do not use staples to secure the insulation. For proper temperature maintenance, insulation must be properly sized, complete and sealed, pipe hangers shall be outside of the insulation. Insulate through floor penetrations or otherwise protect the cable form damage. Insulate over all tee's, splices and end seals, after system testing, mark their location on the insulation and install “Electric Traced” labels every ten feet.

O. Install caution labels every ten feet on piping insulation where piping is equipped with electric heating cable.

P. The plumbing contractor shall field mark all hot water pipes to be traced for the installer, include plumbing riser numbers on each floor for easy identification.

Q. Install the heating cable linearly on the pipe after the piping has successfully pressure tested. The heater cable shall be protected from damage especially at pipe hangers, riser clamps, floor and wall penetrations. Secure the heating cable to piping with fiberglass tape.

R. Install electric heating cable including drops to the fixtures and horizontal pipe in chases behind the fixtures to within 2’ of fixture, in accordance with the plans and the manufacturer’s instructions.

S. All power connections, tee's, splices and end seals shall be clearly and permanently labeled with circuit no. and riser no. Each power connection shall also be tagged with installed length and wattage of cable, using tags provided by the manufacturer.

T. Connect the cable to wall mounted electrical junction boxes (J-Boxes). If the controller is a single circuit controller it shall be installed between power connection and the junction box by this contractor. The Division 26 Electrical contractor shall furnish and install the ground fault circuit breakers, J-Boxes and all inter-connecting electrical. This contractor shall verify the location and type of each the 30 milliamp trip ground fault circuit breakers which power each circuit and note them on his as-built system drawings.

U. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.

V. Grounding of controller shall be equipment according to Division 26.

W. Connection of all electrical wiring shall be according to Division 26.

X. Protect installed heating cables, including non-heating leads, from damage and exposed cable ends from moisture during construction.

3.3 FIELD QUALITY CONTROL

A. The manufacturer's factory trained personnel shall provide installation training and periodic supervisory visits during installation, testing and commissioning of the electric heating cable system.

B. The plumbing contractor shall coordinate start-up / testing of completed system sections with the Owner and Electrical Contractor.

C. Testing During Installation: The Contractor shall perform tests in accordance with the manufacturer's requirements. The installing contractor is responsible for testing runs of cable during installation, at the conclusion of work each day, prior to walls or ceilings being closed. Testing includes meggering to insure cable integrity, capacitance testing to verify installed length and continuity and visual inspection for damage and conformity to design.

D. Visual Inspection: Inspect pipe, insulation and connections of cable checking for physical damage. Check that no staples were used to secure the insulation and the thickness conforms the scheduled requirements in this section. Check that the insulation is dry and no moisture is present in the electrical connections.

E. Final Commissioning & Warranty:
   1. After the contractor has tested the system and after the pipe insulation has been installed, the capacitance, and megger tests shall be performed again and shall be witnessed by the Construction Manager, and the manufacturer or the manufacturer's representative.
   2. Contractor shall conduct a temperature performance acceptance test of the system, to insure that hot water is maintained in accordance with design and a power verification test. Tests shall be conducted in the presence of the Construction Manager.
      a. Temperature Performance Test, proceed as follows:
         1) Turn the off cold water supply to eliminate any possibility of hot / cold cross connections.
         2) Turn off the water heater.
         3) Power the electric heating cable system for 4 hours, or overnight.
         4) PRIOR to any water use, check and record the water temperature and time for the water to reach design temperature at all faucets - starting at the fixtures closest to the hot water supply main and work out into the system.
         5) NOTE: If the manufacturer has authorized a deviation from their published insulation guidelines due to the expected operating patterns of the buildings' hot water system, the acceptable temperature under this test may be lower than the nominal system design temperature. If this is the case, the manufacturer shall provide a statement of acceptability for this test.
   3. Power Verification Test, proceed as follows:
      a. Check pipe temperature under thermal insulation or water temperature at most remote fixture of each circuit.
      b. Check power at lighted end seals.
      c. Measure voltage and current at the power connection for each circuit.
      d. Calculate the power drawn by multiplying volts by amps.
      e. Calculate, at design temperature of 140 °F for electric heating cable, the power and amperage drawn per foot of circuit length, it should equate to approximately 0.017 amps/ft.
   4. Verify the insulation schedule is in compliance with the manufacturer’s Installation and Operation manual or Engineering Specifications, whichever is more stringent.
   5. Verify that the controllers are set to the application requirements.
   6. Verify that the controllers are connected to and properly configured for BMS interface.

3.4 FIELD TESTING

A. Refer to Section 26 05 03 for additional testing requirements for electric heating cable systems.

B. The material shipments shall include a detailed installation and maintenance manual for all products included in shipment.

C. The local manufacturer's representative shall maintain qualified field service personnel to assist in installer training, system commissioning and basic troubleshooting.

END OF SECTION 225522

SECTION 229000 - PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Test and balance reports
5. Record drawings
6. Permit requirements
7. Valve tag list

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the plumbing systems.

B. Within 30 days of the first major milestone submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary – Plumbing

☐ All required submittals have been submitted and either been approved or modified in accordance with the Engineer’s “make corrections noted” comments.

☐ All equipment has been started up and is functioning within manufacturers’ recommendations without any undue noise or vibration. (Submit a list of equipment with startup dates. Provide list at a point 65% into construction schedule).

☐ All vibration isolation has been installed and is operating properly.

☐ Access doors have been installed as required for concealed equipment, water hammer arrestors, valves, controls, actuators, etc.

☐ All equipment has been installed with the manufacturers recommended service clearances and is fully accessible for required maintenance.

☐ All equipment and piping is labeled per specifications.

☐ All action items are complete as listed in the action items reports. Submit a list of action items with sign off by Architect or Engineer for record. Punch list to be completed prior to turn over of building.

☐ Contractor to test all drains to verify that they are clear and draining properly upon project completion.

☐ Operation and maintenance manuals submitted with table of contents and required documentation for extended warranties.

☐ Factory Testing documented and submitted for record.

☐ Record drawings submitted per specifications.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 COORDINATION WITH OTHERS

A. The Division 21 through 23 contractor shall coordinate his requirements with the General Contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 21 through 23 systems.

3.3 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION 229000

SECTION 230501 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Divisions 21, 22, 23, 24, 25, 26, 27 and 28 contractor(s) shall comply with the provisions of this section. The Divisions 21, 22, 23 and 25 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26, 27 and 28 contractor(s).

B. The Electrical Contractor and Mechanical Contractor shall be responsible for coordinating any work requiring communication with the BMS, metering, monitoring, or other communication system. Electrical Contractor shall provide required communication protocol, ports, and wiring as required for connection of metering, ATS, UPS, etc to the BMS or other communication system.

C. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21, 22, 23 and 25 System Contractor performing the work, which requires the electrical power.

1. Each Divisions 21, 22, 23 and 25 contractor shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26, 27 and 28 specifications, NEC and local codes.

1.2 WORK INCLUDED

A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and Division 23 and 25 (control) before submitting any equipment for review or commencing installation.

1.3 DEFINITIONS

A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.

B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.

C. Motor Control Center: A floor mounted assembly of one or more enclosed vertical sections having a common horizontal power bus and primarily containing motor starting units.

D. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.

E. Manual Operation: Operation by hand without the use of any other power.

F. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.

G. TC: Temperature Controls = Division 22, 23 or 25 Contractor who furnishes control.

H. EC: Electrical Contractor = Divisions 26, 27or 28 Contractor.

I. FA: Fire Alarm Contractor = Division 25 or 28 Contractor who furnishes Fire Alarm System.

J. SC: Sprinkler Contractor

K. EP: Electric to Pneumatic Converter.

L. PE: Pneumatic to Electric Converter.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21, 22, 23 and 25 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnished By	Set In Place By	Power Wiring By	Control Wiring By
AHU Interior Marine Lights	MC	MC	EC	EC
Equipment Motors	MC	MC	EC	--
Automatically or Manually Controlled Starters/Contactors: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
Motor Speed Controllers: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC, EC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC, EC or TC	MC or TC	--	TC
Control Transformers	MC or TC	MC or TC	EC or TC	TC
Push Button Stations, Pilot Lights	MC	EC	EC	EC
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	MC, EC or TC	MC or TC	MC or TC	TC
Equipment in Temperature Control Panels	TC	TC	TC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	TC	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	TC	MC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC

ITEM -	Furnished By	Set In Place By	Power Wiring By	Control Wiring By
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	SC	SC	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	--	TC/FA
Relays for Fan Control via duct detectors (Note 5)	MC	MC	EC	TC/FA
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	FA	--	FA
Smoke Management Controls (Note 7)	FA	FA	EC	FA
CO Sensors	TC	TC	TC	TC
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 7)	MC	MC	EC	FA/TC (Note 7)
Smoke Control Dampers (for smoke management system) (Note 7)	MC	MC	EC	FA/TC (Note 7)
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC (Note 7)
Electrical Metering	EC	EC	--	EC (Note 8)
Transfer Switches	EC	EC	EC	EC (Note 8)
Uninterruptible Power Supplies	EC	EC	EC	EC (Note 8)

Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring and connections by EC. Electrical Contractor shall provide disconnects for all electrical equipment unless otherwise indicated.
2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor. Such devices shall be provided at low voltage unless technically impossible
3. Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided by the electrical contractor.
4. Electrical contractor is responsible for wiring from disconnect to starter and from starter to motor, unless factory wired.
5. Temperature control contractor shall provide conduit and wire from auxilary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.
6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.
   a. Electrical Contractor shall provide all power and control wiring to fire/smoke or smoke dampers. HVAC, Controls, Electrical, and Fire Alarm Contractors shall provide parallel control wiring (with fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes, unless otherwise indicated.

b. Fire alarm system shall override automated building control system during smoke exhaust mode.
c. TC shall provide additional required wiring and controls when damper also serves a temperature control or zoning function.

7. FA wires to components necessary for the operation and monitoring of the Smoke Management System. TC wires to components utilized in the control and monitoring of the Automated Building Control System. This often requires dual wiring where components are controlled by both. In such case wiring and relays shall be provided to ensure FA takes precedence in control over TC.
8. EC responsible to coordinate and bring control wiring to BMS control panel or other communication system for monitoring and control of item. BMS Vendor shall provide all programming as necessary. Coordinate exact requirements with Owner and Engineer.

B. Power Wiring by Divisions 21, 22, 23 and 25: The electrical power for certain equipment provided under Divisions 21, 22, 23 and 25 may not be specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21, 23 or 25 trade requiring such power.

Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards is the responsibility of the Divisions 21, 23 and 25 trade requiring the power.

1. Such equipment is hereby defined as:
   a. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing drawings.
   c. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings and schedules. Provide junction box and or receptacle as required by manufacturer.
   d. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in HVAC scope and will be shown by that contractor’s control submittal drawings.
   e. Motorized dampers and VAV boxes. Required locations and specification are shown on the mechanical drawings and HVAC specifications. HVAC contractor shall provide damper, controls and power.

1.5 GENERAL REQUIREMENTS

A. Connections:

1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

B. Starters:

1. Provide magnetic starters for all three phase motors and equipment complete with:
   a. Control transformers.
   b. 120V holding coils.
   c. Integral hand-off-auto switch.
   d. Auxiliary contacts required for system operation plus one (1) spare.
   e. Refer to Motors, Starters and Drives, requirements for additional information.

C. Remote Switches and Pushbutton Stations:

1. Provide remote switches and/or pushbutton stations required for manually operated equipment (if no automatic controls have been provided) complete with pilot lights of an approved type lighted by current from load side of starter.

D. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

E. Identification:

1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

F. Control Voltage:

1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

G. DDC Control Interface:

1. Fully coordinate the requirements of each division with regard to supplying a complete DDC Control System prior to submitting bid.
2. All power to controllers and controlled equipment shall be furnished via dedicated line voltage circuits.
3. Dedicated control circuits from electrical panelboards to DDC control panels and from electrical panelboards to dedicated DDC J-boxes (for distributed control components such as VAV boxes), and control transformer line voltage connections shall be provided by HVAC Contractor where required.
   a. Exceptions: Where power wiring has been shown on Electrical Drawings.
4. Low voltage wiring from J-boxes to distributed control components, all low voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23 or 25.
5. Any additional power requirements shall be the responsibility of the Division 23 or Contractor requiring same, and provided at no additional cost to the owner.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
2. Steam and condensate piping.
3. Hydronic main piping (12” and larger).

4. Plumbing vent piping.
5. Supply, return and exhaust ductwork.
6. Electrical conduit greater than 3” diameter.
7. Hydronic branch and mains (greater than 2”, but less than 12”).
8. Domestic water mains piping.
9. Fire sprinkler mains and leaders.
10. Hydronic branch piping (2” and less).
11. Domestic water branches.
12. Electrical conduit branch feeders.
13. Pneumatic control piping.
14. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, extending from the face of the ceiling to an elevation 2” above the height of the light fixtures.

C. Examine the contract documents of all trades (e.g. all Divisions 21, 22, 23, 25, 26 and 28 the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise unaccessible locations.

1. For equipment located in “accessible locations” such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. “Normal maintenance” includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.
2. All system components requiring access shall be grouped together to reduce the quantity of access doors required.

G. See “Basic Mechanical Materials and Methods” for additional access door requirements if section has been included in this specification.

PART 2 – PRODUCTS

2.1 MOTOR HORSEPOWER

A. In general, all motors ½ HP and above shall be three phase, all motors below ½ HP shall be single phase.

B. Voltage and phase of motors as scheduled on the electrical drawings shall take precedence in the case of a conflict between the mechanical and electrical drawings or general condition 2.1.

A., above.

C. Work under Divisions 21, 22 and 23 includes coordinating the electrical requirements of all mechanical equipment with the requirements of the work under Divisions 26, 27 and 28, before ordering the equipment.

1. If motor horsepowers are changed under the work of Divisions 21, 22 or 23 without a change in duty of the motor's driven device, coordination of additional electrical work (if any) and additional payment for that work (if any) shall be provided under the section of Divisions 21, 22 or 23 initiating the change. Increases or decreases in motor horsepower from that specified shall not be made without written approval from the Architect/Engineer.

PART 3 - EXECUTION - (Not Used)

END OF SECTION 230501

SECTION 230502 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1 - General Requirements.

B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. Architect/Engineer shall decide which is more stringent.

C. Provisions of this section shall also apply to all sections of Divisions 21, 22 and 23.

1.2 DEFINITIONS

A. The definitions of Division 1 and the General Conditions of this specification also apply to Divisions 21, 22, 23 and 25 Contract.

B. “Contract Documents” constitute the drawings, specifications, general conditions, project manuals, etc., prepared by Engineer (or other design professional in association with Engineer) for contractor’s bid or contractor’s negotiations with the Owner. Divisions 21, 22, 23 and 25 drawings and specifications prepared by the Engineer are not construction documents.

C. “Construction Documents”, “construction drawings”, and similar terms for Divisions 21, 22, 23 and 25 Work refer to installation diagrams, shop drawings and coordination drawings prepared by the contractor using the design intent indicated on the Engineer’s contract documents. These specifications detail the contractor’s responsibility for “Engineering by Contractor” and for preparation of construction documents.

D. “(E)” indicates "existing" equipment on site which may or may not need to be relocated as a part of this work.

E. “(R)” indicates existing equipment to be relocated as part of this work.

F. "Furnish" means to "supply" and usually refers to an item of equipment.

G. "Install" means to "set in place, connect and place in full operational order".

H. "Provide" means to "furnish and install".

I. “Equal” or "Equivalent" means "meets the specifications of the reference product or item in all significant aspects." Significant aspects shall be as determined by the Architect/Engineer.

J. "Work by other(s) divisions"; "re:_____ Division", and similar expressions means work to be performed under the contract documents, but not necessarily under the division or section of the work on which the note appears. It is the contractor’s sole responsibility to coordinate the work of the contract between his/her suppliers, subcontractors and employees. If clarification is required, consult Architect/Engineer before submitting bid.

K. By inference, any reference to a “contractor” or “sub-contractor” means the entity, which has contracted with the Owner for the work of the Contract Documents.

L. "Engineer" means the design professional firm, which has prepared these contract documents. All questions, submittals, etc. of this division shall be routed to the Engineer (through proper contractual channels).

M. “Piping” includes, in addition to pipe, all fittings, valves, hangers and other accessories related to such piping.

N. “Concealed” means hidden from sight as in chases, furred spaces shafts, hung ceilings, or embedded in construction.

O. “Exposed” means, “not concealed” as defined above. Work in trenches, crawl spaces, and tunnels shall be considered “concealed” unless otherwise specifically noted.

P. “Governmental” means all municipal, state and federal governmental agencies.

Q. Where any device or part of equipment is herein referred to in the singular number (such as “the pump”), such reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the Drawings.

R. “HVAC” means Heating, Ventilating and Air Conditioning.

S. “Plumbing Contractor” means the Contractor doing Plumbing work.

T. “Fire Protection Contractor” means the Contractor doing Fire Protection work.

1.3 COORDINATION

A. Contract Documents:

1. General: The Contract Documents are diagrammatic showing certain physical relationships, which must be established within the Division’s work and its interface with other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
2. Supplemental Instructions: The exact location for some items in this Specification may not be shown on the Drawings. The location of such items may be established by the Architect/Engineer during the progress of the work. Make reasonable modifications in the layout as needed to prevent conflict with work of other trades.
3. Discrepancies:
   a. Examine Drawings and Specifications of all Divisions of the work.
   b. Report any discrepancies to the Architect/Engineer and obtain written instructions before proceeding.
   c. Should there be a conflict within or between the Specifications or Drawings, the most stringent or higher quality requirements shall apply.
   d. Items called for in either specifications or drawings shall be required as if called for in both.
4. Constructability:
   a. Examine Drawings and Specifications of all Divisions of the work.

b. Report any issues to the Architect/Engineer which may prevent installation of Divisions 21, 22, 23 and 25 work in accordance with the Contract Documents and the original construction contract.
c. Report all issues within *30 days* after contract.

B. Be responsible for providing proper documentation of equipment product data and shop drawings to all entities providing service. This coordination shall include, but not be limited to, the following:

1. Fire Protection Contractor shall provide shop drawings to HVAC and Plumbing Contractors.
2. Automatic Temperature Controls, Building Management and Test-Adjust-Balance Contractors shall be provided with equipment product data and shop drawings as appropriate from all other contractors, and shall furnish the same information about control devices (such as valves, test wells, etc.) to the appropriate Contractors.

C. Coordination Drawings:

1. Submit coordination drawings for all HVAC, Plumbing, Fire Protection and Electrical work. The drawings shall be fully coordinated and signed off by all affected trades prior to submission. The coordination drawings shall include the following at a minimum:
   a. All major ductwork, piping, conduit and equipment.
   b. Reflected ceiling plans with light fixtures.
   c. Current architectural floor plans.
   d. Major structural elements.
   e. Elevations of piping ductwork or equipment.
   f. Sections through critical spaces.
2. The drawings shall be at a suitable scale (3/8”=1’-0” minimum) to clearly show information.
3. Any work installed without approved coordination drawings is done at the Contractor’s risk.

D. CAD Drawings:

1. Electronic Auto Cad drawings are available from M-E Engineers. The service charge for the delivery of these files is $200 per floor plan per trade. Contractor will be required to execute a file transfer agreement.

E. Existing Conditions:

1. Inspect existing conditions prior to bidding.
2. Provide proper coordination of mechanical work with existing conditions.

F. Utility Connections:

1. Coordinate the connection of mechanical and electrical systems with the Civil drawings and utility companies.
2. Comply with regulations of utility suppliers.
3. The Contract Documents indicate the available information on existing utilities and services, and on new services (if any) to be provided to the project by utility companies and agencies.

a. Notify Architect/Engineer immediately if discrepancies are found.

4. Coordinate mechanical utility interruptions one week in advance with the Owner and the Utility Company. Plan work so that the duration of the interruption is kept to a minimum. This shall include premium time, shift labor and multiple crews to accelerate the work and lessen the impact on facility operations.

G. If the project is constructed under multiple bid packages each Contractor shall coordinate their work with the progress of the other contractors performing similar or unrelated work.

H. Coordinate ceiling cavity space carefully with all trades.

I. Coordinate with Electrical Work.

J. Cutting and patching as specified.

K. Chases, Inserts and Openings:

1. Provide measurements, drawings, and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided. Any cutting and patching made necessary by failure to provide measurements, drawings, and layouts at the proper time shall be done at no additional cost to the Owner.
3. Coordinate roof openings for all roof-mounted equipment. Openings on documents are diagrammatic and do not represent manufacturer specific requirements. Actual opening size, orientation and location, as well as structural coordination, is the responsibility of the mechanical contractor. Provide transitions on ductwork to accommodate actual roof openings.

L. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other Sections of the Specifications can be built at the proper time.

M. The work throughout shall be executed as quickly as conditions permit in the best and the most thorough manner under the direction of and to the satisfaction of the Engineers, Owners and Architects, who will jointly interpret the meaning of the Drawings and Specifications, and shall have the power to reject any work and materials which, in the judgment, are not in full accordance therewith.

N. The work called for under this contract shall be carried on simultaneously with the work of other trades in a manner such as not to delay the overall progress of the work. Furnish promptly to other trades involved at the project, all information and measurements relating to the work which they may require. Cooperate with them in order to secure the harmony necessary in the interest of the project as a whole.

O. Keep a competent superintendent in charge of the work at all times. Such superintendent shall be replaced if unsatisfactory to the Owner.

P. Upon award of contract, consult with the Architect and negotiate with subcontractors and manufactures, and within thirty (30) days submit five (5) copies of a preliminary list of major equipment, for approval, complete with name of manufacturer, dates of purchase orders, and delivery dates to the site. Also submit within thirty (30) days, five (5) copies of a preliminary

schedule of installation of the various systems. The list shall be revised monthly and five (5) copies shall be submitted. The second submittal shall contain the names of manufacturers of scheduled equipment (with names, addresses, and telephone numbers of local representatives).

Q. Maintain a complete file of shop drawings at all times available to the Owner's representatives.

R. Every facility shall be provided to permit inspection of the work by the Owner's representatives during the course of construction.

S. Where items of equipment and/or materials are indicated in the Specifications as being furnished by other trades for installation, assume responsibility for the unloading of such equipment and/or materials from the delivery trucks, and for providing safe storage for same as required pending installation.

T. Where the work is to be installed in close proximity to work of other trades, or where there is evidence that the work is to interfere with work of other trades, assist in working out space conditions to make a satisfactory adjustment.

Prepare composite working drawings and sections at a suitable scale not less than 3/8" = 1'-0" clearly showing how the work is to be installed in relation to the work of other trades. If the installation is made before coordinating with other trades, make all necessary changes in the work without extra charge to the Owner.

1.4 COORDINATION WITH EXISTING OCCUPIED AREAS

A. Minimize disruptions to operation of building systems in occupied areas.

B. Provide temporary connections to prevent long disruptions.

C. Provide multiple crews, premium time labor and/or shift labor to reduce duration of work and impact on the facility.

D. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such regular time or at overtime when designated by the Owner. Assume all connections to existing operational systems will be on premium time, provide a credit for all work allowed to occur on normal time.

E. The Owner shall be notified of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed.

F. When it is necessary to drain down all or part of an existing or new system the Contractor performing such work shall be responsible for providing all labor, materials, equipment, etc for the completion of the system draining and refilling where applicable. The base scope of the project shall include all premium time or shift labor required to accomplish this work.

G. All work shall be coordinated with the Owner or their designated representative who may wish to provide oversight of the process or witness the work at their discretion.

H. Prior to the start of any work the Contractor shall prepare a "Summary of Impact" document which shall detail; the systems to be affected, the areas impacted (in sufficient detail to allow

evaluation), the duration of the proposed shut-down under ideal conditions, a summary of the potential risks (possible but unexpected complications) of the shut-down and all measures being taken to address the potential risks, the potential duration of the shut-down should unexpected complications occur, plans for temporary systems to mitigate the impact of the shut-down and any other items relevant to assessing the impact on the facility.

I. The "Summary of Impact" document should also identify any steps that have been taken to limit the scope and duration of the shut-down. This may include identification and testing of isolation valves, an investigation of multiple isolation valves that provide different levels of system isolation and shut-down extent, multiple teams working in multiple areas during a single shut-down to reduce the total quantity of shut-downs, etc.

J. With respect to wet systems, the subcontractor should provide all labor, materials, ladders, tanks, pumps, scaffolding, hoses, equipment, etc. required to perform systems shutdowns including but not limited to the furnishing and installation of temporary valves, system purge, access holes for pumping of low areas, wet taps for drain of low areas, removal and re-installation of heat tracing, insulation, BMS controls as applicable, etc. All recovered materials shall be disposed of properly with manifests and chain of custody documents where required by Codes or Law.

K. No work shall begin until all materials have been delivered to the job site. Contractor shall obtain and store spare quantities of products and materials required to complete the shut-down in the event that the materials planned for use prove to be defective or are damaged during installation. Where the scope of a repair is uncertain the contractor shall obtain and store all reasonable combinations of parts as may be required to adapt to the conditions that may be discovered during the progression of the work.

1.5 RELOCATIONS AND REHABILITATION OF EXISTING SYSTEMS

A. It is expected that the Contractors will regularly encounter situations where; existing systems conflict with the proposed location of new systems, existing systems that are exposed by the work may be in a condition that is not recommended for continued use, existing systems may be "orphaned" by the removal of existing work in adjacent areas, or existing systems may need to be relocated or replaced for any other reason. Each trade Contractor shall submit a completed unit costs table, as detailed in specification section 23 05 01/26 05 01 1.7, to be used for establishing pricing of such relocation/rehabilitation work.

1.6 ENGINEERING BY CONTRACTOR

A. The construction of this work requires the Contractor to perform certain design activities with regard to several of the Contract Mechanical systems or subsystems that can only be fully ascertained with regard to the prevailing site field conditions during construction activities. All such designs and related activities shall be the complete responsibility of the Contractor. Where these design activities require engineering, it is the responsibility of the Contractor to engage the service of a licensed New York State Professional Engineer experienced in the areas related to the design activities performed by the Contractor.

B. Systems or subsystems which require engineering responsibility by the contractor include, but are not limited to:

1. Any system not fully detailed on the drawings.
2. Fire sprinkler and hydraulic calculations.
3. Equipment supports, not fully detailed in the drawings.
4. Pipe supports, hangers and anchors not specified in these documents, or cataloged by the manufacturer and miscellaneous steel as required.
5. Vibration isolators and seismic restraints.
6. Duct supports, hangers and miscellaneous steel as required.
7. Temperature controls.
8. Refrigeration systems.
9. Piping expansion and contraction provisions.
10. Steam piping stress analysis and calculations.
11. Equipment supports, hangers.
12. Ductwork support systems.

C. Contractor's design responsibility shall include system design, any required calculations to support system design, any compliance documents or certifications by any governing body up to and including replacement of design engineer with a different engineer of record, retained and paid by the contractor, as determined by authorities or original design engineer. Where supplemental steel is required to support piping or equipment, the supplemental steel shall be designed to provide a maximum deflection of L/360 at the midspan under the supported load. The piping or equipment shall be isolated from the building structure by means of isolators as required by the mounting type specified for the piping and/or equipment.

D. Contactor shall complete all controlled or special inspections and file all required paperwork in a timely manner. Professional engineer retained by contractor to serve as "special inspector" shall meet all requirements for special inspector as determined by the authority having jurisdiction.

E. Where the contract documents indicate "Verify in Field" or "Contractor to Verify" or other similar terms, the contractor shall be responsible for verifying the extent of the work by performing field investigations prior to submitting their bid. All costs associated with performing the complete scope of work, as determined by the contractor's field verification, shall be included in the contractor's bid price.

1.7 REGULATORY REQUIREMENTS

A. Codes: Comply with the latest editions of the following:

1. International Building Code.
2. International Mechanical Code.
3. International Plumbing Code.
4. Building Code of the State of New York.
5. Mechanical Code of the State of New York
6. Plumbing Code of the State of New York
7. New York State Energy Conservation Code
8. National Electric Code.
9. ASME Boiler and Pressure Vessel Code.
10. Local Modifications to above Codes.

B. Applicable NFPA Standards.

C. Requirements of Local Utility Companies:

1. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required for the project.

D. Other Regulations: Comply with the latest editions of the following:

1. U.S. and State Department of Labor Safety Regulations pertaining to the completed project.
2. Requirements of Fire Departments serving the project. Including FDNY.
3. Regulations of the Health Department having jurisdiction. Including New York State and New York City D.O.H.
4. Regulations of the Fire Marshal.
5. ASHRAE Energy Conservation Standard 90A.
6. ASHRAE Ventilation Standard 62.
7. ASHRAE 90.1.
8. ASHRAE 13
9. ASHRAE 135
10. Americans with Disabilities Act (ADA).
11. Clean Air Act.
12. Clean Water Act.
13. NFPA National Fire Protection Association
14. ANSI American National Standards Institute
15. ASTM American Society for Testing Materials
16. AWWA American Water Works Association
17. IBR Institute of Boiler and Radiator Manufacturers
18. NEMA National Electric Manufacturers Association
19. SMACNA Sheet Metal and Air Conditioning National Association, Inc.
20. ARI Air Conditioning and Refrigeration Institute
21. UL Underwriters' Laboratories
22. AMCA Air Moving and Conditioning Association
23. ADC Air Diffusion Council
24. AABC Associated Air Balance Council
25. Local Water Company Rules and Regulations

E. Additional Regulations: Follow additional regulations, which appear in individual Sections of these Specifications.

F. All piping shall be domestically manufactured and shall be by the same manufacturer.

G. Contradictions: Where codes are contradictory, follow the most stringent, unless otherwise indicated in Plans or Specifications. Architect/Engineer shall determine which is most stringent.

H. Contract Documents Not in Compliance:

1. Where the Drawings and Specifications do not comply with the minimum requirements of the Codes, either notify the Architect/Engineer, in writing during the Bidding Period, of the revisions required to meet Code requirements, or provide an installation which complies with the Code requirements. After entering into contract, Contractor will be held to

complete all work necessary to meet these requirements without additional expense to the Owner.

2. Follow Drawings and Specifications where they are superior to Code requirements.

I. Contractor as Technical Expert

1. When the contractor declares himself to be an expert with regard to how a system must be constructed or what will be required to gain code official approval, it shall be assumed that the contractor was an expert at the time of bid and has included all costs associated with proclaimed “required” work in his base bid.

J. The Contractors bid shall be based on the execution of all work required to allow the contractor to self-certify the work of the project. Self-certification shall be performed if requested by the Owner. Submitting a bid for the contract work shall be considered confirmation by the contractor that he is in good standing with the department of buildings with respect to self-certification.

K. Work of contract shall be bid as described in contract document including all details, notes, plans, routing, etc. Contractor’s intentional or unintentional exclusion of scope or assumptions about alternate construction methods, configurations, materials or testing shall be at the contractors risk and the engineer reserves the right to require that the work be constructed per plans. Statements such as “I did not bid it that way”, or “I don’t have that in my price”, shall be understood to be an admission of the contractors error but will have no effect in reducing the contract requirements or increasing the cost to the Owner.

L. Permits

1. Obtain all permits required by authorities and agencies having jurisdiction for the work of this Division.
2. Post permits as required.
3. Obtain all approvals, including controlled inspections, prior to request for final payment.

M. Tap and Connection Fees:

1. Pay fees charged by Utilities for making connections, bringing service to property line, or to meter and similar services.
2. Investment fees or plant development fees, which are charges levied by Utilities to cover the cost of the utility system to be borne by this project, are not part of the work of this Division.

N. Inspections and Tests:

1. Arrange for all required inspections and tests.
2. Pay all charges.
3. Notify Architect/Engineer 48 hours before tests.
4. Submit one copy for Owners records of permits, licenses, inspection reports and test reports.

1.8 RECORD DRAWINGS

A. General Recording Procedure:

1. Maintain a blue-line set of Sprinkler, Plumbing and HVAC Contract Drawings in clean, undamaged condition, for mark-up of installations, which vary, from the Contract Drawings.
2. Record changes drawn to scale and fully dimensioned.
   a. Work concealed behind or within other work, in an inaccessible arrangement.
   b. Mains and branches of piping systems:
      1) with valves and control devices located and numbered.
      2) with concealed unions located.
      3) with items requiring maintenance located (traps, strainers, expansion compensators, tanks, etc.).
   c. Underground piping and ducts, both exterior and interior.
   d. Ductwork layouts, including locations of coils, dampers, filters, boxes and similar units.
   e. Concealed control system devices and sensors.

B. Corrected Drawings:

1. Obtain a set of contract drawings on CAD.
2. Update the CAD files to reflect as-built conditions.
3. Transmit corrected CAD files and plots as a submittal to the Architect/Engineer for Owner's use and record.

C. Temperature Control Drawings:

1. Provide as-built Drawings of work under this contract including:
   a. Ladder wiring diagram.
   b. Pneumatic schematic diagrams.
   c. One line system diagram.
   d. Control schematic of equipment with control devices located and identified.
   e. Wiring or tubing termination diagrams.
   f. List of materials.
   g. Floor plan indicating all device locations.
   h. Control sequences.
   i. Indicate electrical power source for each point of connection to the electrical system.
2. Reproducible temperature control drawings and computer files shall be delivered to the Architect/Engineer prior to Owner's acceptance of project.

1.9 OPERATING AND MAINTENANCE DATA

A. Submission:

1. Submit typed and bound copies of Operating and Maintenance Manuals prior to scheduling systems demonstration for the Owner.
2. Bind each Maintenance Manual in one or more vinyl covered, 3-ring binders, with pockets for folded drawings. Mark the back spine of each binder with system identification and

volume number.

B. Required Contents:

1. Manuals shall have index with tab dividers for each major equipment section to facilitate locating information on specific piece of equipment.
2. Identify data within each section with drawing code numbers as they appear on Drawings and Specifications. Include as a minimum the following data:
   a. Alphabetical list of system components, with the name, address and 24 hour telephone number of the company responsible for servicing each item during the first year of operation. Include point of contact for company.
   b. Operating instructions for complete system including:
      1) Emergency procedures for fire and failure of major equipment.
      2) Major start, operation and shut-down procedures.
   c. Maintenance Instructions for each piece of equipment including:
      1) Equipment lists.
      2) Proper lubricants and lubricating instructions for each piece of equipment.
      3) Necessary cleaning, replacement and/or adjustment schedule.
      4) Product Data.
      5) Installation instructions.
      6) Parts lists.
      7) Complete wiring diagrams.
   d. Temperature control diagrams and O&M information as specified above (as-built).
   e. Marked or changed prints locating concealed parts and variations from the original system design (as-built drawings).
   f. Balancing Report.
   g. Valve schedule and associated piping schematics. See “Identification” specification sections.
   h. Copies of any extended equipment warranties, which are greater than one year.

1.10 WARRANTIES

A. The warranty period is one year after Date of Acceptance.

1. During this period, provide labor and materials as required to repair or replace defects in the mechanical system at no additional cost to the Owner. Provide certificate with O&M manual submittal which guarantees same-day service response to Owners call for all such warranty service.
2. Provide certificates for such items of equipment which have warranties in excess of one year. Insert copies in O&M manuals. Such equipment shall include, but not be limited to:
   a. Temperature Control Valves five (5) years.
3. Provide extended manufacturers warranties to cover one full year from date of acceptance if standard warranty starts any time prior to that date.
4. Provide factory trained service personnel for all warranty work on the following equipment:

   a. Building Management System
   b. Air Handlers
   c. Packaged Equipment

B. Refer to Division 1 for additional requirements.

1.11 INDEMNIFICATION

A. Pay all royalties and defend all suits or claims for infringement of any patent rights and save the Owner harm from loss on account thereof.

B. If process or article specified is an infringement of patent, promptly notify the Architect in writing, and any necessary changes shall be as provided in the Contract for changes in the work. If the Contractor performs any work specified knowing it to be an infringement of patent, he shall bear all costs arising therefrom.

C. Take out all necessary insurance, free of extra charge, and agree to indemnify and save harmless the party contracting for services against loss or expense, by reason of the liability imposed by law upon such party for damages because of bodily injuries, including death at any time resulting therefrom, accidentally sustained by any person or persons or on account of damage to property arising out of or consequence of the performance of this Contract, whether such injuries to persons or damaged property are due or claimed to be due by any negligence in the performance of the Contract, the party contracting for services, employees or agents, or any other person.

1.12 SCOPE

A. The Contractor shall:

1. Supply all labor, transportation, materials, apparatus, light, and tools necessary for the completion of the mechanical work.
2. Install, maintain, and remove all construction equipment.
3. Be responsible for safe, lawful, and proper construction execution.
4. Construct, in the best and most workmanlike manner, a complete project and everything properly incidental thereto, as shown on the Drawings, as stated in the Specifications, or reasonably implied therefrom, all in accordance with the Contract documents.

B. Work Included

The Work includes the providing of all labor, materials, equipment, accessories, services and tests necessary to complete and make ready for operation by the Owner, all Heating, Ventilating and Air Conditioning Work, as shown on the Drawings and hereinafter specified, including, but not limited to the following.

1. All motor starters and controllers for equipment furnished by this Contractor. Packaged type units shall be furnished completely pre-wired with panels mounted on the units as specified. All other motor starters and controllers will be turned over to the Electrical Contractor for installation and wiring.
2. Interior alteration work, removals, replacements, relocations, etc. to the existing mechanical systems in all renovated areas as indicated on the Drawings. Modify existing low pressure steam system as required to serve new equipment.
3. Filters.
4. Fans.
5. Steam radiators and convectors.

6. Complete VRF system including evaporators, condensers, refrigerant piping, and all interconnect wiring.
7. Packaged rooftop AC units complete with electric heating coils, controls and electric power.
8. Condensate pumps and piping to floor drain or janitor sink.
9. Make final steam and condensate pipe connection to all equipment.
10. Steam specialties such as traps, strainers, etc.
11. Accessories such as V-belt drives, flow measuring devices, draft gauges, machinery guards, thermostats, pressure gauges.
12. Piping, fittings, and valves.
13. Sheet metal ductwork and accessories, including dampers, access doors, etc.
14. Registers, grilles and diffusers.
15. Fire dampers, smoke dampers and fire/smoke dampers.
16. Installation of smoke detectors in ductwork.
17. Acoustical duct lining, where specified or shown on drawings.
18. Pipe, duct and equipment insulation.
19. Variable volume air terminals.
20. Temperature Control: A complete system of temperature control shall be installed in connection with the HVAC systems, including all thermostats, air piping, damper motors, etc. All control wiring for automatic temperature controls, including interlocking wiring for fans, chillers, pumps, etc. by this Contractor, unless otherwise shown on the electrical Drawings.
21. Painting and pipe identification for all work by this Contractor is previously specified under “Special Requirements for Mechanical and Electrical Work”.
22. Test and balancing.
23. Sleeves, pipe inserts and anchor bolts, escutcheons, prefabricated roof curbs, etc., as hereinafter specified.
24. Identification, name plates, tags and charts.
25. Cutting and rough patching.
26. Furnishing and setting of electric motors.
27. Furnishing of starters, motor control centers and motor control devices as specified under “Special Requirements for Mechanical and Electrical Work”.
28. Templates and anchor bolts for equipment bases.
29. Cap flashing for pipe and duct passing through roof.
30. Removal, relocation and/or demolition of any existing hanging rods that are in conflict with the installation of HVAC work.
31. Furnishing of access doors.
32. Energy management (building automation) system.
33. Concrete pads for all HVAC work.
34. Installation of fire and smoke dampers in the existing ductwork and fan systems.

1.13 SPECIAL INSPECTIONS

A. Contactors shall provide all required special inspections for all work performed. Contractor shall retain a third party Architect or Engineer, independent of the primary design team and contractor, to complete all required inspections and execute all required TR-1 documents and any additional documents that may supplement or replace these documents in the future.

B. Contractors’ special inspection engineer shall be in good standing with the Department of Buildings and shall meet all requirements and qualifications established by the Department of Buildings. This shall include education, formal training, in-service training, corporate structure,

certifications, professional development, etc. If, at any time, the Architect or Engineer shall fail to meet the qualification requirements of the Department of Buildings the contractor shall replace the Architect or Engineer with another qualified professional.

C. If at any time the Architect or Engineer shall fail to produce required inspections and associated documentation in a timely manner, the contractor shall replace the Architect or Engineer with another qualified professional.

D. All inspections shall be completed in strict accordance with the requirements established by the Department of Buildings. Records of inspections shall be maintained in accordance with good practice, but in no case less than 6 years from time of filing. Documentation shall be in accordance with requirements established by NYSDOB.

E. The work of the project will be phased and completed on an accelerated schedule. This will create a need for multiple inspections and inspection documentation filings. Architect and Engineers performing inspections shall fully understand the phasing of the work and be prepared to complete inspections and provide filing documents in accordance with the established schedule. The inspector shall expect that multiple inspection visits may be required to support a single inspection filing.

F. Special inspector shall have no financial interest in the construction, installation, maintenance of structures or components that they inspect.

G. Special inspector shall cooperate with any audits or inquiries initiated by NYSDOB or other authorities having jurisdiction.

H. Special inspectors shall limit the scope of their inspections to systems and installations that their education, experience, certifications, etc., qualify them to inspect.

I. Special inspectors shall report any discrepancies or deficiencies to the contractor immediately upon detection and shall follow-up with contractor to confirm that conditions have been corrected or repaired.

J. Special inspection agencies shall carry insurance in the coverage limits established by NYSDOB. At a minimum, this shall be a $500,000 professional liability policy, $1,000,000 general liability and other statutory insurance at statutory limits.

K. Special inspection agencies shall have a full time director in responsible charge that does not serve as an inspector or director for any other testing agencies.

L. Controlled/special inspections shall be provided as follows:

1.	Fire Dampers, Fire Smoke Dampers, Smoke Dampers	BC 1704.16
2.	Fire-Resistant Penetrations and Joints	BC 1704.27
3.	Emergency Lighting	BC 1704.31, BC 2702
4.	Ventilation System	BC 1704.16
5.	Mechanical Systems	BC 1704.16
6.	Refrigeration System	BC 1704.16
7.	Mechanical Demolition	BC 1704.20.4, BC 3306.6
8.	Heating Systems	BC 1704.25

9.	Post-installed Anchors (BB# 2014-018, 2014-019)	BC 1704.32
10.	Seismic Isolation	BC 1707.8

1.14 MANDATORY GOVERNING PROVISION

A. Omissions of words or phrases, such as “the Contractor shall,” “in conformity with,” “shall be,” “as noted on the Drawings”, “according to the Drawings”, “an”, “the”, and “all”, may or may not be intentional.

B. Omitted words or phrases shall be supplied by inference.

1.15 PROTECTION OF PROPERTY AND MATERIALS

A. Provide protection against dust migration, rain, wind, storms, frost, or heat, so as to maintain all work, materials, apparatus, and fixtures free from injury or damage.

B. At end of each day’s work, cover all new work likely to be damaged.

C. Do not interrupt the integrity of the building security during periods when the project is staffed or during periods where the project isn’t staffed.

1.16 OWNER FURNISHED EQUIPMENT

A. All equipment called out in the Specifications or shown on the Drawings as “Owner-Furnished Equipment” shall be installed and connected under this Contract. Provide rough-ins, and final connections for all equipment.

B. Kitchen and sterilization equipment will be furnished and set in place under other Sections of the Specifications.

C. Furnish and install all shutoff valves and traps and piping for each item of equipment. Any additional pipe and fittings required for kitchen and sterilization equipment, made necessary by roughing outlets not being located where shown on the manufacture’s approved Drawings, shall be furnished and installed by the Contractor.

D. All such work that is not concealed in the construction or in base cabinets or compartments, shall be polished nickel and chromium plated red brass pipe, with cast brass fittings, cast brass escutcheons, valves, and traps all finished with polished chromium plating over nickel plating.

E. All work in connection with such equipment shall be done under the supervision of the manufacturer and the Contractor shall be responsible for any damage to any of the equipment that may result from his work in connection therewith.

1.17 TEMPORARY FACILITIES

A. Light, Heat, Power, etc.

1. Temporary power and lighting shall be provided by the electrical contractor.
2. Temporary heat shall be provided by the HVAC Contractor.

3. The contractor shall be responsible for maintaining acceptable indoor air quality in adjacent occupied spaces.

B. Use of Permanent Building Equipment for Temporary Heating or Cooling.

1. Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. The contractor shall protect all equipment and systems as directed by the engineer. The warranty period shall not start until the equipment is turned over to the Owner for his use. The contractor shall provide extended warranties for parts and labor for all such equipment. Equipment shall not be turned over to the Owner until the temperature controls have been tested and accepted by the Owner and Engineer. Equipment shall be prepared and turned over to owner in as-new condition.

1.18 ROUGH-IN FOR FUTURE CONNECTION

A. Provide rough-in services for all systems which shall extend to future equipment or spaces as shown on the drawings.

1. Provide sufficiently sized branch plumbing lines with isolation valves to serve future equipment.
2. Provide sufficiently sized BMS/ATC master control panel(s) to accommodate a 20% increase in the number of equipment unit controllers and/or connected control points.

1.19 INSTALLATION GENERAL REQUIREMENTS

A. Furnish, apply, install, connect, erect, clean, and condition manufactured materials and equipment as recommended in manufacturer's printed directions (maintained on job site during installation).

B. Provide all attachment devices and materials necessary to secure materials together or to other materials. Erect, install, and secure components in a structurally sound and appropriate manner.

C. Make allowance for ample and normal expansion and contraction for all building components and piping systems that are subject to such.

D. Install materials only when conditions of temperature, moisture, humidity, and conditions of adjacent building components are conducive to achieving the best installation results.

E. Where necessary, temporarily brace, shore, or otherwise support members until final connections are installed. Leave all temporary bracing, shoring, or other structural supports in place as long as practical for safety and to maintain proper alignment.

F. Store and handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking, rusting, or other disfigurement. Materials damaged for these reasons shall be replaced at no additional cost to Owner.

G. Conduct work in a manner to avoid injury or damage to previously placed work. Any work so impaired or damaged shall be replaced at no expense to Owner.

H. Fabricate and install materials true to line, plumb, and level.

I. Leave finished surfaces smooth and flat, free from wrinkles, warps, scratches, dents, and other imperfections.

J. Furnish materials in longest practical lengths and largest practical sizes to avoid all unnecessary jointing.

K. Make all joints secure, tightly fitted, and as inconspicuous as possible by the best accepted practice in joinery and fabrication.

L. Consult Engineer for mounting height or position of any unit not specifically indicated or located on Drawings or specified in Specifications.

M. Job mixed multi-component materials used in the work shall be mixed in such regulated and properly sized batches that material can be used before it begins to “set”. Mixing of a partially “set” batch with another batch of fresh materials will not be accepted and entire batch shall be discarded and removed from site. Clean all mixing tools and appliances that can be contaminated prior to mixing of fresh materials.

N. In addition to the above refer to each Section of the Specifications for additional installation requirements for the proper completion of all work.

O. Piping or ductwork connected to equipment may require different size connection than indicated on the Drawings. The Contractor shall provide transition pieces as required at the equipment, at no additional cost.

1.20 SCAFFOLDING, RIGGING AND HOISTING

A. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery into the premises of all equipment and materials furnished under this Section of the Specifications, and remove same from premises when no longer required.

B. In the event that supplementary bracing of the basic building structure is required to assure a secure rigging procedure and a secure route for the equipment being handled, assume full responsibility for such supplementary bracing.

1.21 TOOLS

A. All specified tools for proper operation and maintenance of the equipment shall be delivered to the Owner’s representative and a receipt requested for the same at no additional cost to the Owner.

1.22 QUIET OPERATION

A. All equipment and material shall operate under all conditions of load without any sound or vibration which, in the opinion of the Architect, is objectionable. Where sound or vibration

conditions arise which are considered objectionable by the Architect, eliminate same in a manner approved by the Architect.

1.23 RUBBISH REMOVAL

A. See to it that the Project is, at all times, maintained free of all rubbish, rubble, waste material, packaging materials, etc. accumulating as a result of this work. Assume responsibility for the cleaning up of packaging removed from materials and equipment furnished by other trades for the installation. Note that final acceptance of the work is contingent upon the project being free of all excess and waste materials resulting from the work.

1.24 DELIVERY OF MATERIAL

A. Deliver the material and store same in spaces indicated by the Architect and assume full responsibility for damage to structure caused by any overloading of the material or storage in spaces exposed to moisture, humidity, or other environmental conditions.

B. Hoods which will be duct-connected in the field shall be received and set in place by HVAC Contractor.

1.25 ALTERATIONS

A. All equipment, piping, ductwork, etc. to be removed shall be disposed of, turned over to the owner or salvaged as directed by the Owner. They shall not be removed from the premises without the Owner's approval.

B. When new work and alterations render equipment, piping and ductwork useless, such equipment, piping and ductwork shall be removed and connections thereof to lines or ducts remaining shall be properly capped or plugged and left in construction. If construction, such as hung ceiling, furred beams, chase, etc., is opened up and removed during the course of the construction, the useless pipe and ducts therein shall be completely removed

C. No dead ends shall be left on any piping or ductwork upon completion of job.

D. When existing piping and duct systems, at points of connection to new work or in rerouting are found defective, such defective portions shall be removed and replaced with new materials without cost to the Owner.

E. The existing system shall be left in perfect working order upon completion of all new work.

F. Locations and sizes of existing piping are approximate. Exact sizes and locations of all existing piping shall be verified at the site.

G. No removed existing piping, fittings, valves, ductwork, dampers, etc. shall be reused.

H. All existing to remain piping that is rendered inoperable or orphaned by demolition shall be reconnected to nearest active systems during the completion of work in a given space. See additional requirements for shut-down coordination.

I. In instances where the removal of existing wall finishes reveals piping or systems that are not indicated for demolition, but are located in an area that conflicts with the proposed floor plan,

the existing piping or system shall be relocated to a position that does not conflict with future finishes.

J. Provide temporary supports where required.

K. Where alterations reveal piping, ductwork, conduit circuits, wiring, and accessories that must necessarily remain in service, same shall be rerouted, replaced or altered as required to make same completely concealed in the new work at no additional cost to the Owner.

L. Where existing piping or ductwork insulation is damaged by the requirements of the work, replace all damaged insulation to match existing.

M. This Contractor shall not interrupt any of the services of the existing facility, nor interfere with the services in any way without the express permission of the Owner. Such interruptions and interferences shall be made as brief as possible and only at the time stated by the Owner.

N. Under no circumstances shall this Contractor or his workmen be permitted to use any part of the facility as a shop, except parts designated by the owner for such purposes.

O. Provide branch shut-off valves as required to install new work without continuous shut-down of entire building chilled water, condenser water, hot water, and steam systems

1.26 PAINTING

A. Paint all unpainted, non-insulated, non-galvanized, ferrous metal surfaces of pipes, conduits, ducts, equipment, fixtures, hangers, supports and accessories as follows:

1. Exposed and Concealed - one prime coat of primer and one coat of oil varnish based paint, color selected by Architect.
2. Underground - two coats of black asphaltum paint.
3. The inside of all ductwork where visible through openings shall be painted with two prime coats of dull black paint.

B. Nameplates on all equipment shall be cleaned and left free of paint. One finish coat of enamel color to be identified by architects.

PART 2 – PRODUCTS

2.1 QUALITY CONTROL

A. Manufacturers of equipment or materials will fall into one of the following categories:

1. "Basis of Design" - The manufacturer of equipment or materials listed on the Drawings or first named in the Specifications. If the Drawings and Specifications are in conflict, the drawings shall take precedence.

2. "Approved Equal" - Manufacturers whose products are listed in the Specifications under "Approved Equal"

3. "Substitution" - Manufacturers whose products are not listed in the Specifications.

B. Requirements applicable to all submittals:

1. Refer to Section 230502 / 2.2 - General Submittal Requirements

2. Provide Specification Compliance with all Submittals:

a. Contractor/Manufacturer shall submit the all relevant specification sections within the submittal indicating that they comply with each line item of each of the relevant specification section(s). For any item that doesn't comply, the contractor/manufacture shall clearly indicate why not and how their product meets or exceeds the requirement of that line item.

C. Requirements applicable to submission of "Approved Equals":

1. The submittal shall include a cover sheet indicating the following, signed by the contractor:

a. The proposed product will not affect dimensions shown on Drawings.
b. The contractor will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the submission.
c. The proposed product will have no adverse effect on other trades, the construction schedule, operation and maintenance, and specified warranty requirements.
d. Maintenance and service parts will be locally available for the proposed product.

2. The contractor shall be responsible for coordinating the required dimensions, clearances, access points and other service locations such that the submitted product properly fits in the available space allocated for the Basis of Design.

3. Provide all features which are standard on the Basis of Design, whether or not specifically specified or scheduled.

D. Requirements applicable to submission of "Substitutions":

1. Products by manufacturers not listed in the specifications may not be used as the basis of the bid price.

2. Substitution Request Form: Use Architect's Substitution Request Form, if one is not provided by the architect, utilize CSI Standard Form 13.1A.

3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, dimension, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Operation, maintenance, and efficiency difference.
f. Samples, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research/evaluation reports evidencing compliance with building code in effect.
j. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

4. A/E will review Substitution Request and indicate one of the following actions:

a. Substitution Request Approved as Noted - Make submittals in accordance with “Approved Equal” Requirements.
b. Substitution Request Rejected - Use specified materials.

5. Under no circumstances should the substitution result in added cost to the project.

E. Shop drawings shall not be submitted prior to approval of all equipment submittals.

F. The materials, workmanship, design, and arrangement of all work installed under the Contract shall be subject to the approval of the Architect or Engineer.

G. If material or equipment is installed before it is approved, each trade installing same shall be liable for the removal and replacement at no extra charge to the Owner if, in the opinion of the Architect or Engineer, the material or equipment does not meet the intent of the Drawings and Specifications.

H. It is the intent of these Specifications that wherever a “Basis of Design” manufacturer of a product is specified, the submitted item must conform in all respects to the “Basis of Design” specified item. Consideration will not be given to claim that the substituted item meets the performance requirements with lesser construction (such as lesser heat exchange surface, reduced horsepower, etc.). Performance as delineated in schedules and in the Specifications shall be interpreted as minimum performance.

I. Being listed in the specifications as a “Basis of Design” or “Approved Equal” manufacturer does not permit the manufacturer to provide standard manufactured equipment which does not comply with the performance and/or physical characteristic requirements of the Contract Documents.

J. All equipment and materials required for installation under these Specifications shall be new and without blemish or defect. All electrical equipment shall bear labels attesting to Underwriter's Laboratories approval. Where no specific indication as to the type or quality of the material or equipment is indicated, a first class standard article shall be furnished.

K. Where it is proposed to use an item of equipment other than specified “Basis of Design” which requires any redesign of the structure, partitions, foundations, piping, wiring, or of any other part of the mechanical, electrical, or architectural layout, all such redesign, and all new drawings and detailing required therefore shall, with the approval of the Architect or Engineer, be prepared at no additional cost to the Owner. On multiple prime contracts the substituting contractor shall negotiate with other prime contractors to have alternate work performed without cost to the owner.

L. All equipment of one type (such as fan coil units, etc.) shall be the product of the same manufacturer.

M. Note that the approval of shop drawings or other information submitted in accordance with the requirements hereinbefore specified does not assure that the Engineer, Architect, or any other Owner's representative attests to the dimensional accuracy or dimensional suitability of the material or equipment involved or the mechanical performance of equipment. Approval of shop drawings does not invalidate the Plans and Specifications if the shop drawings are in conflict with the Plans and Specifications.

N. With regard to proprietary or partially proprietary systems, including but not limited to building automation, automatic temperature controls, fire alarm, signaling, monitoring, data center alarm systems, etc., the specification of system components by a single manufacturer shall not be questioned. No discussion about inter-operability or open protocols will be considered. Contractor shall assume that engineer has previously considered substitutions of non-proprietary systems or open protocols and rejected this option.

2.2 GENERAL SUBMITTAL REQUIREMENTS

A. Coordination and Sequencing:

1. Coordinate submittals 2 weeks (min.) prior to expected order date so that work will not be delayed by submittals.
2. No extension of time will be allowed because of failure to properly coordinate and sequence submittals.
3. Do not submit product data, or allow its use on the project until compliance with requirement of Contract Documents has been confirmed by Contractor.
4. Submittal is for information and record, unless otherwise indicated, and is not a change order request. Approval of alternate equipment or notations on shop drawings shall not be considered to be approval of additional cost.
5. Submitting contractor is responsible for routing reviewed submittals to all parties affected including but not limited to electrical, temperature control, and test and balance subcontractors.
6. All submittals requiring expedited review shall be made at the start of the project. Submittals requiring expedited review due to delay of submission will be reviewed on engineering premium time which will be back-charged to the contractor.

B. Preparation of Submittals:

1. Refer to Division 1 requirements.
2. Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, Supplier, submittal name and similar information to distinguish it from other submittals.
3. Indicate any portions of work which deviate from the Contract Documents.
   a. Explain the reasons for the deviations.
   b. Show how such deviations coordinate with interfacing portions of other work.
4. Show Contractor's executed review and approval marking.
5. Provide space for Architect's/Engineer's "Action" marking.
6. Submittals which are received from sources other than through Contractor's office will be returned "Without Action".
7. Submittals shall be presented in a neat and legible fashion and shall be returned "Without Action" if presented in any other fashion.
8. Electronic submittals shall be subject to a minimum $50 document processing charge per submittal up to 50 letter size pages or 15 sq. ft. of wide format printing. Larger quantities will be subject to increased charges. Charges shall be deducted from payments to the Contractor by the owner.
9. Contractor is responsible for submission of shop drawings in accordance with plans and specifications for compliance with the system description and manufacturer. Shop drawings submitted, which are not in substantial compliance requires additional and unnecessary review time by the Engineer and Architect. Shop drawings submitted more than once, which are not in substantial compliance, shall be reviewed at a rate of $225 per hour and charged to the contractor. Charges shall be deducted from payment to the contractor by the owner.

C. Quantities: Unless otherwise indicated in Division 1, submit six copies.

1. Refer to Division 1 requirements.
2. Multiple System Items: Where a required submittal relates to an operation or item of equipment used in more than one system, increase the number of final copies as necessary to complete the Maintenance Manuals for each system.
3. Preliminary Submittal: Provide a preliminary, two-copy submittal for automatic temperature controls and when product data is required (or desired by Contractor) for selection of options by Architect/Engineer.
4. General Distribution:
   a. Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to Subcontractors, Suppliers, Fabricators, Installers, Governing Authorities and others as necessary for proper performance of the work.
   b. Include such additional copies in transmittal to Architect/Engineer where required to receive "Action" marking before final distribution.
      1) Show such distributions on transmittal forms.

D. Response to Submittals: Where standard product data have been submitted, it is recognized:

1. That the Submitter has determined that the products fulfill the specified requirements.
2. That the submittal is for the Architect's or Engineer's information only, but will be returned with appropriate action where observed to be not in compliance with the requirements.

E. If more than two submissions (either for shop drawings, as-built drawings, or test and balance reports) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

2.3 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

A. Manufacturer's Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out significant portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:
   a. Sizes
   b. Weights
   c. Speeds
   d. Capacities
   e. Piping and electrical connection sizes and locations.
   f. Statements of compliance with the required standards and regulations.
   g. Performance data.
   h. Manufacturer's specifications and installation instructions.
   i. Certified performance curves for all pumping and fan equipment shall be submitted for approval.
   j. Samples of materials or equipment, when requested by the Architect, shall be submitted for approval.
   k. Samples, drawings, specifications, catalogs, etc., submitted for approval, shall be properly labeled indicating project name, specific service for which material or equipment is to be used, Section and Article number of Specifications.
   l. Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested, shall be specific and identification in catalog, pamphlet, etc., of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.
   m. Approval rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are approved, said approval does not in any was relieve responsibility, or necessity, of furnishing material or performing work as required by the Contract Drawings and Specifications.
   n. Prior to submission of shop drawings, thoroughly check each shop drawing, reject those not conforming to the Specifications, and indicate (by signature) that the shop drawings submitted meet Contract Requirements.
   o. All shop drawings showing routing of ductwork, piping and conduit, shall be not less than 3/8" = 1'0" scale.

B. Shop Drawings:

1. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale.
   a. Show clearance dimensions at critical locations.
   b. Show dimensions of spaces required for operation and maintenance.

c. Show interfaces with other work, including structural support.

C. Test Reports:

1. Submit test reports which have been signed and dated by the firm performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.

D. Required equipment and shop drawing submittals:

1. Provide a submittal schedule with bid.
2. Provide equipment submittals for each item of equipment specified or scheduled in the contract documents.
3. Submittal Schedule shall show each item of equipment, applicable Section of the specifications where it is described, applicable Drawing number and schedule name where it is scheduled, date of Contractor's proposed submittal to Architect, required date to receive submittal from Architect and schedule order date.
4. Provide a Mechanical Shop Drawing Schedule for submission to the Architect with the Submittal Schedule.
5. Before request for acceptance and final payment for the work, write a letter to the Architect stating that all shop drawings are brought to a condition "Reviewed" or "Exception as Noted ". Any outstanding shop drawings must be cleared with the Engineer.

E. Submit shop drawings covering the following items:

1. Coordination drawings.
2. Packaged Rooftop Unit
3. VRF System and all components.
4. Internal cleaning and treating of piping.
5. Sleeve and ductwork penetration drawings.
6. Identification schedule and samples.
7. Air filters and draft gauges.
8. Coils.
9. Expansion joints, anchors and guides, including details of installation.
10. Air diffusers, registers and grilles.
11. Schedule of ductwork, joints, gauges, supports, flexible connections, fire dampers, access doors, etc.
12. Centrifugal fans, and power roof ventilators and propeller fans.
13. Sheet metal fabrication drawings.
14. Schedule of steam traps.
15. Machinery guards and V-belt drives.
16. Roof vent fittings.
17. Schedule of piping and fitting materials.
18. Piping shop drawings.
19. Schedule of valves, strainers, vacuum breakers.
20. Flow metering device and systems.
21. Thermometers and pressure gauges.
22. Schedule of pipe and ductwork supports, including inserts, escutcheons, etc.
23. Heating systems, including unit heaters, cabinet heaters, fintube radiation, convectors, etc., as specified.

24. Outside air supply unit including coils, filters, draft gauges, etc.
25. All motor starters, motor control devices and motor control centers.
26. Schedule of insulation types and samples of each type.
27. Vibration isolation schedule including inertia block details.
28. Templates for equipment bases.
29. Acoustic material (internal duct lining).
30. VAV and constant air valve boxes.
31. Building management system.
32. Air vents, air separators, water strainers, reducing safety valves for water systems.
33. Concrete pad location and size.

F. All shop drawings being submitted that include electrical work shall be submitted with all internal and external wiring diagrams.

G. The previously listed items are major equipment and do not limit this Division's responsibility to submit shop drawings for all equipment and accessories which are to be provided under this Division of the Specifications.

2.4 COMPATIBILITY

A. General: Provide products which are compatible with other products of the mechanical work, and with other work requiring interface with the mechanical work.

B. Altitude Ratings: Except where noted otherwise, all ratings and capacities stated in the Contract Documents are at the altitude of the project.

C. Power Characteristics:

1. For power characteristics of equipment supplied under Division 21, 22 and 23 Sections, refer to the Sections of Divisions 26, 27 and 28 and the Electrical Drawings for the power characteristics of each power driven item of mechanical equipment.
2. Coordinate available power with Electrical Contractor before ordering equipment. Mechanical Contractor shall be responsible for ordering equipment to meet the available power characteristics.
3. See also Division 23 05 01 of these specifications.
4. If there is a conflict between Divisions 21, 22 and 23 documents and Divisions 26, 27 and 28 documents, alert the engineer. Do not order equipment prior to determining the proper electrical service. No contract cost adjustment will be allowed for equipment ordered in conflict with the available power characteristics.

2.5 SAFETY PROVISIONS

A. Equipment Nameplates: Provide power-operated mechanical equipment with a permanent nameplate attached by the manufacturer, indicating:

1. The manufacturer
2. Product name
3. Model number
4. Serial number
5. Speed
6. Capacity

7. Power characteristics
8. Labels of testing, listing, or inspecting agencies.
9. Other similar data

B. Where manufacturer affixed nameplate is not available, Mechanical Contractor shall fabricate and attach nameplate.

C. Guards:

1. Unless equivalent guards are provided integral with the equipment, enclose each belt drive (including sheaves) on both side in a galvanized, one inch, mesh screen of No. 18 gauge steel wire or expanded metal, fastened to an approved, structural steel frame, securely fastened to the equipment or floor.
2. Provide tachometer holes at shaft centers. Unless equivalent guards are provided integral with the equipment, install a solid guard of No. 20 gauge galvanized steel over the coupling of each item of direct-driven equipment.

D. Refrigerant

1. Any refrigeration system containing any refrigerants listed in the Clean Air Act as a Class I or Class II Ozone Depleting Compound shall comply with the Clean Air Act.
2. As a minimum all systems shall be equipped with refrigerant recovery service valves, relief valves capable of resetting after activation, and for system with more than 50 pounds of charge, and isolateable receiver and/or condenser capable of holding the complete charge.
3. Any refrigerant removed from systems shall be recovered in accordance with Clean Air Act.

PART 3 – EXECUTION

3.1 COORDINATION OF MECHANICAL INSTALLATION

A. Inspection and Preparation:

1. Examine the work interfacing with mechanical work, and the conditions under which the work will be performed, and notify the Architect/Engineer of conditions detrimental to the proper completion of the work at original contract price.
2. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Layout:

1. Layout the mechanical work in conformity with the Contract Drawings, Coordination Drawings and other Shop Drawings, product data and similar requirements so that the entire mechanical plant will perform as an integrated system, properly interfaced with other work, recognizing that portions of the work are shown only in diagrammatic form.
2. Where coordination requirements conflict with individual system requirements, comply with the Architect's or Engineer's decision on resolution of the conflict.
3. Take necessary field measurements to determine space and connection requirements.

4. Provide sizes and shapes of equipment so the final installation conforms to the intent of the Contract Documents.

C. Integrate mechanical work in ceiling spaces with suspension system, light fixtures and other work so that required performances of each will be achieved. Modification of duct work sizes from contract documents to sheet metal shop drawings for coordination purposes shall be included in the contractor's scope of work, confirm new ductwork dimensions with the engineer.

3.2 PRODUCT INSTALLATION

A. Manufacturer's Instructions:

1. Except where more stringent requirements are indicated, comply with the product manufacturer's instructions and recommendations.
2. Consult with manufacturer's technical representatives, who are recognized as technical experts, for specific instructions on special project conditions.
3. If a conflict exists, notify the Architect/Engineer in writing and obtain his instruction before proceeding with the work in question.

B. Movement of Equipment:

1. Wherever possible, arrange for the movement and positioning of equipment so that enclosing partitions, walls and roofs will not be delayed or need to be removed.
2. Otherwise, advise other Contractors of opening requirements to be maintained for the subsequent entry of equipment.

C. Return Air Path: Coordinate mechanical work in return air plenum to avoid obstructing return air path.

1. Do not make changes in layout which will reduce return air path cross-sectional areas. Minimum cross-sectional area will provide an average of 500 fpm and a maximum of 750 fpm velocity through return air plenum at specified supply air quantity unless otherwise noted.
2. Provide openings in any full height walls to allow for free movement of return air. Openings are to be sized for 500-750 fpm velocity. Provide fire or fire/smoke dampers at openings in fire rated walls, even if not specifically shown on the drawings.
3. Report any obstructions by work of other Divisions to Architect/Engineer.

D. Coordinate location of all floor mounted work (piping, ductwork, supports, etc.) in all areas (including mechanical rooms) to avoid obstruction of egress path.

E. Clearances:

1. Install piping and ductwork:
   a. Straight and true.
   b. Aligned with other work.
   c. Close to walls and overhead structure (allowing for insulation).
   d. Concealed, where possible, in finished spaces.
   e. Out-of-the-way with maximum passageway and headroom remaining in each space.

2. Except as otherwise indicated, arrange mechanical services and overhead equipment with a minimum of:
   a. 8'-0" headroom in storage spaces.
   b. 8'6" headroom in other spaces; where approved by Architect.
3. Do not obstruct windows, doors or other openings.
4. Give the right-of-way to piping systems required to slope for drainage (over other service lines and ductwork).

F. Access:

1. Provide for removal, without damage to other parts, of:
   a. Coils
   b. Tubes
   c. Shafts
   d. Fan wheels
   e. Drives
   f. Filters
   g. Strainers
   h. Bearings
   i. Control components
   j. Other parts requiring periodic replacement or maintenance
2. Connect equipment for ease of disconnecting with minimum of interference with other work.
3. Provide unions where required.
4. Locate operating and control equipment and devices for each access.
5. Provide access panels where units are concealed by non-accessible finishes and similar work.
6. Extend all grease fittings to an accessible location.

3.3 PROTECTION OF WORK

A. All pipe ends, valves, ducts, and equipment left unconnected shall be capped, plugged or otherwise properly protected to prevent damage or the intrusion of foreign matter.

B. Do not allow any fans in the HVAC system to operate before the area served by the fan has been cleaned and vacuumed of all debris and dust which might enter the system.

C. Any equipment, duct or piping systems found to have been damaged or contaminated above "MILL" or "SHOP" conditions shall be replaced or cleaned to the Engineer's satisfaction.

D. Provide initial water seal fill for all waste P-traps, condensate traps, or similar traps.

3.4 PROTECTION OF POTABLE WATER SYSTEMS

A. All temporary water connections shall be made with an approved back flow preventer.

B. All hose bibs shall have as a minimum, a vacuum breaker, to prevent back flow.

C. Direct connections to hydronic systems shall only be made through a reduced pressure zone back flow preventer. Backflow drain shall be piped to drain to nearest floor drain or mopsink.

3.5 PROTECTION OF SYSTEMS SERVING OCCUPIED SPACES

A. Where work is being performed in occupied spaces, or occupancy is to be phased in with ongoing construction, contractor shall prevent contamination of all systems serving the occupants including but not limited to:

1. Supply Or Return Air
   a. Systems shall be capped or provided with adequate particulate and gas phase filtration to prevent dust, chemical, or biological contamination. Particulate filters shall be, as a minimum, equivalent to those specified for the completed system.
2. Domestic Water
   a. Isolate sterilized portions from non-sterilized portions.
3. Medical Gases
   a. Isolate certified portions from non-certified portions.

3.6 REFRIGERATION SYSTEMS

A. All techniques involved in the installation of refrigeration systems shall be by certified staff trained in accordance with the state and local requirements, and the applicable sections of the Clean Air Act.

B. No refrigerant shall be intentionally vented to the atmosphere. All refrigerant shall be recovered before opening a closed system for charging, evacuation or service. Equipment being demolished that contains R-170, R-290, R-600, R-600W, R-1150, R-1270 type refrigerants shall be subject to the approval of the commissioner of the Fire Department.

C. All refrigerant installed shall be new unless approved by the Engineer.

D. The Contractor shall be responsible and accountable for compliance with the EPA Clean Air Act (CAA) Section 608, 40 CFR Part 82 and any state or local codes for all refrigerant related work. In general, an EPA-certified technician shall perform any activity involving refrigerant-containing equipment that includes: (1) attaching and detaching hoses and gauges to and from refrigerant containing equipment to measure pressure; (2) adding refrigerant to, or removing refrigerant from equipment; or (3) any other activity that violates the integrity of a refrigerant containing circuit (for example any activity where a refrigerant containing circuit is ‘opened’ in any manner).

E. Refrigerant and oil shall be recovered from any equipment that does not meet the definition of a small appliance in 40CFR Part 82 Subpart F before removal and subsequent disposal. Small appliances (as defined in 40CFR Part 82 Subpart F) may be removed from the site with the charge (refrigerant) intact, provided it is properly labeled and handled in such a manner so as to prevent damage to coils. Small Appliances are defined in 40CFR Part 82 Subpart F as: Any appliance that is fully manufactured, charged, and hermetically sealed in a factory with five (5) pounds or less of a Class I or Class II substance used as a refrigerant, including, but not limited to, refrigerators and freezers (designed for home, commercial, or consumer use), medical or industrial research refrigeration equipment, room air conditioners (including window air conditioners and packaged terminal air heat pumps), dehumidifiers, under-the-counter ice makers, vending machines, and drinking water coolers.

F. All new equipment installed shall utilize non-CFC refrigerants.

G. Prior to starting construction, demolition, or service work Contractor shall provide to Owner a list of all service technicians with EPA certification numbers and level of certification. (Copies of EPA certification cards are acceptable for those who will be working on the site.)

H. Contractor shall provide to the Owners Representative all Service Invoices (or equivalent service documentation acceptable to owner) for all work performed by EPA- certified Technicians. Service Invoices (or equivalent documentation) shall include the following information at a minimum for each piece of refrigerant containing equipment serviced:

- Date of Service
- Name of EPA-Certified Technician
- Technicians Certification Level
- Type of Equipment Serviced
- Equipment Manufacture
- Equipment Model and Serial Number
- Description of Service Performed
- Date Leak Discovered (if applicable)
- Date Leak Repaired (if applicable)
- Date Follow-Up Leak Test Performed (if applicable)
- Type of Refrigerant
- Normal System Full Charge (in pounds)
- Amount of Initial Refrigerant Charge Recovered During Service
- Amount of Recovered Refrigerant Returned to System
- Type of Additional Refrigerant Added to System
- Amount of Additional Refrigerant Charged to System
- System Charge at End of Service

I. Contractor shall provide Owners Representative a copy of complete manifests, invoices, or other documentation showing any refrigerant removed from the project by the contractor was disposed of appropriately or reclaimed by an EPA-certified Reclaimer.

3.7 LEAK TESTING

A. All new equipment not meeting the definition of a small appliance, including packaged equipment, factory charged, field charged, split systems or field-constructed systems with field-installed refrigerant piping shall be leak tested prior to or during startup. Leak testing shall utilize appropriate electronic leak-testing equipment.

B. Leak testing shall be conducted by an EPA-certified technician. The contractor shall provide written verification of the leak testing and results.

C. If a leak is detected, the following procedure shall be followed:

1. Notify the Owner’s Site Representative (who will notify the Refrigerant Compliance Coordinator).
2. Document the leak.
3. Repair the leak.

4. Document the procedures followed.
5. Leak test to verify the leak was repaired.
6. Schedule and provide a 30-day follow-up verification leak test witnessed by a designated HVAC technician.
7. Document follow-up leak testing.
8. Repeat the above process if follow-up leak is detected.

3.8 DEMOLITION PROCEDURE FOR EQUIPMENT REMOVED BY CONTRACTOR

A. The Contractor, in contractor-provided refrigerant recovery cylinders, shall take ownership of the recovered refrigerant and transport off site to a proper disposal company or certified reclaimer.

B. Service Invoices, as described in RECORD DOCUMENTS, shall be provided.

C. The Contractor technician shall tag the unit that the refrigerant was removed.

D. Once an EPA-certified technician has removed the refrigerant and tagged the unit, a noncertified person may perform the remainder of the demolition.

3.9 ASBESTOS

A. The identification and/or abatement of asbestos hazards is not part of this trade contract. If asbestos is encountered, contact Owner for instructions.

3.10 START-UP

A. Tests shall be performed to the satisfaction of the Architect. The Architect will be present at such test, when he deems necessary and such other parties as may have legal jurisdiction.

B. Pressure tests shall be applied to piping only before connection of equipment and installation of insulation. In no case shall piping, equipment, or accessories be subjected to pressure exceeding their rating.

C. All defective work shall be promptly repaired or replaced and the tests shall be repeated until the particular system and component parts thereof receive the approval of the Architect.

D. Any damages resulting from tests shall be repaired or replaced and the tests shall be repeated until the particular system and component parts thereof receive the approval of the Architect.

E. The duration of tests shall be as determined by all authorities having jurisdiction, but in no case less than the time prescribed in each Section of the Specification.

F. Equipment and systems which normally operate during certain seasons of the year shall be tested during the appropriate season. Tests shall be performed on individual equipment, systems, and their controls. Whenever the equipment or system under test is interrelated with and depends upon the operation of other equipment, systems and controls for proper operation, functioning, and performance, the latter shall be operated simultaneously with the equipment or system being tested.

G. The electrical work shall include providing any assistance (such as removal of switchboard and panelboard trims and covers, pull and junction box covers, etc.) deemed necessary by the

Architect to check compliance with the Drawings and Specifications.

H. The Contractor shall assign a Plumbing, Fire Protection and HVAC Start-Up Coordinator to this project.

I. The Start-Up Coordinator shall develop detailed start-up procedures, equipment checkout procedures and data forms for recording compliance with contract document performance criteria, and will assist in developing schedules for checkout and Owner acceptance.

J. The Plumbing, Fire Protection and HVAC Contractors shall include as part of the work of this contract, manpower, equipment, tools, ladders, instruments, etc. necessary to confirm start-up of Plumbing, Fire Protection and HVAC systems.

K. The Test, Adjust and Balancing Contractor shall include as part of the work of his/her contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to assist the Start-Up Coordinator in accomplishing his/her work.

L. The Start-Up Coordinator shall be responsible for maintaining documentation of Start-Up activities until final acceptance of the project.

M. The documentation shall be kept current by the Start-Up Coordinator and shall be available for inspection at all times. At the time of acceptance of the project, the Start-Up Coordinator shall surrender 3 completed copies of the documentation to the Owner's representative.

N. Before Testing, Adjusting, Calibration and Balancing, the Start-Up Coordinator shall confirm, in writing to the Owner, the following:

1. All equipment, components, and systems have been set, started-up, and adjusted.
2. Systems have been established at the appropriate temperatures and pressures for proper operation and performance.
3. All electric power connections, disconnects, fuses, circuit breakers, etc. are properly sized and installed.
4. The operation of all valves, dampers and sensors is positive (per the control sequences) and demonstrated.

O. Provide dated matrices for each item of equipment showing the date each of the start-up activities was witnessed or performed by the Start-Up Coordinator.

1. Start-up and operating performance test documentation shall include all Division 21, 22 and 23 equipment with scheduled or rated capacities.

P. At the completion of the start-up; and test and balance, Plumbing, HVAC and Fire Protection contractors shall conduct a 72 hour dynamic mode demonstration of the systems in the presence of the Owner and Architect/Engineer. Contractor shall be available during the period to adjust equipment operation or setpoints. The engineer may direct the contractor to implement new control sequences or alter system installation in response to data collected during start-up. Work that can be completed by staff assigned to start-up that can be completed in the time period assigned to the start-up shall be completed with out additional cost to the owner.

Q. The Owner may require operation of parts or all of the installation for the beneficial occupancy to final completion and acceptance of the building. The operation shall not be construed to mean acceptance of the work by the Engineer for the Owner. The Owner will furnish supervisory personnel to direct operation of the entire system and the Contractor shall continue to assume this responsibility until final acceptance.

3.11 DEMONSTRATION

A. Refer to Architectural sections of the specifications regarding requirements of Record Drawings and Operation and Maintenance Manual submittal and systems demonstration.

1. Demonstrate to the Architect/Engineer that each system operates in accordance with the contract documents.
2. Explain the operation of each system to the Owner's Representative. Explain use of O&M manual in operating and maintaining systems.

B. Date and time of demonstration will be determined by Owner.

C. Demonstration Requirements.

1. Provide a point-to-point check-out of 100% of BMS controlled points for all equipment.

3.12 PROJECT CLOSEOUT

A. Refer to the individual sections of the specifications for individual closeout requirements.

B. Provide a written schedule of when systems are to be started up, tested and demonstrated along with dates for completion of the temperature controls and balancing. This schedule shall be submitted no later than 30 days prior to starting up and testing equipment.

C. The contractor shall notify the Architect/Engineer no later than 2 weeks in advance of system testing or demonstration.

END OF SECTION 230502

SECTION 230503 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

B. Where contradictions occur between this Section and Division 1, the most stringent of the two shall apply. The design team shall decide which is most stringent.

C. Provisions of this Section shall also apply to all Sections of Divisions 21, 22 and 23.

1.2 SUBMITTALS

A. Manufacturer's Data - Submit manufacturer's data for:

1. Access panels.
2. Fire stopping materials.

B. Application Data - Submit application data for firestopping materials showing UL required installation details for every combination of pipe material, penetrated structure, opening size and required fire rating within the scope of this project. Application data drawings shall include UL system number.

PART 2 – PRODUCTS

2.1 ACCESS PANELS

A. See Architectural specification for access panel types and finishes.

1. If panels are not specified in architectural specification, comply with the following:
   a. Manufacturers:
      1) Design Basis: Milcor Division, Inryco, Inc.
      2) Other Acceptable Manufacturers:
         a) Birmingham Ornamental Iron Co.
         b) Karp Associates, Inc.
         c) Wilkenson Co., Inc.

B. Construction:

1. Doors: 14 gauge steel.
2. Frames: 16 gauge steel.
3. Fire Rating: Equivalent to construction in which installed.
4. Latches: Flush or concealed, ¼ turn.
5. Finish: Selected by Architect.

2.2 FIRE STOPPING MATERIAL

A. Manufacturers:

1. Design Basis: 3M.
2. Other acceptable manufacturers:
   a. GE
   b. Metalines
   c. Hilti

B. General Requirements:

1. Products to be used shall have been tested in accordance with ASTM E 814-88, and be listed in the UL Fire Resistance Directory.

C. Bare Piping:

1. Model: FD 150, or CP-25.

D. Insulated Piping:

1. Model: CP-25 or FS-195, Intumescent.
2. “No-sag” or “self-leveling” as required.

E. Accessories:

1. Provide fasteners, restricting collars, backing materials, and protective coatings as required to comply with the UL system listing.

2.3 SPARE PARTS

A. Filters

1. The Contractor shall furnish a minimum of 2 complete spare filter sets for the filters for all units.

B. Miscellaneous Spare Parts

1. Water column glasses shall be provided for each tank utilizing one.
2. Furnish one complete set of V-belts for each belt driven unit installed.
3. A full set of spare fuses for each VFD drive.

2.4 ESCUTCHEONS

A. Provide escutcheons on pipes wherever they pass through ceilings, walls, floors, or partitions.

B. Escutcheons or pipes passing through outside walls shall be Ritter Pattern and Casting Co., No. 1, solid, cast brass, flat type secured to pipe with set screw.

C. Escutcheons for pipes passing through floors shall be Ritter Pattern and Casting Co., No. 36A, split-hinged, cast brass type, designed to fit pipe on one end and cover sleeve projecting

through floor on the other end.

D. Escutcheons for pipes passing through interior walls, partitions, and ceilings shall be Ritter Pattern and Casting Co., No. 3A, split-hinged, cast beams chromium plated type.

PART 3 – EXECUTION

3.1 CUTTING AND PATCHING

A. Refer to Architectural sections of the Specifications for additional requirements.

B. Provide measurements, drawings and layouts to installers of other work so that required openings may be provided as construction progresses. Any cutting and patching made necessary by failure to provide this information shall be done at no increase in the contract amount.

C. All cutting and patching of existing work required for Plumbing, HVAC and Fire Protection work is included in the scope of the plumbing, HVAC and Fire Protection contracts. Finish patching, painting and restoration of finishes outside of primary work area is the Plumbing, HVAC and Fire Protection contractor performing work. Finish patching, painting and restoration of finishes in primary work area is by others. Rough patching, finish patching, painting and/or restoration of finishes outside of the primary work area is by each trade contractor.

D. Where possible, mark openings to be cut on existing construction. Otherwise, provide measurements, drawings and layouts to the trade doing the cutting so that openings may be provided as construction progresses.

E. Cutting Concrete:

1. Where authorized, cut openings through concrete for pipe penetration and similar services by core drilling or sawing.
2. Do not cut by hammer-driven chisel or drill.

F. Cutting:

1. Cut openings in accordance with layouts, measurements or drawings of the Installer of work requiring openings. Cut openings in concrete by core drilling or sawing; not by hammer-driven chisel or drill.
2. Coordinate the location of all openings with structural drawings. Report any discrepancies to Architect. Do not proceed with work until discrepancies have been resolved.
3. Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work.
4. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage.
5. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

G. Patching:

1. Where patching is required to restore other work because of either cutting or other damage inflicted during the installation of mechanical work, engage experienced craftsmen to complete the patching of the other work.
2. Restore the other work in every respect, including the elimination of visual defects in exposed finishes.
3. All openings in fire rated construction shall be patched and sealed with U.L. approved sealant to maintain the fire integrity of the structure.

H. Perform cutting, patching and restoration of finishes required to:

1. Uncover work to provide installation of ill-timed work.
2. Remove and replace defective work.
3. Remove and replace work not conforming to requirements of the Contract Documents.
4. Remove samples of installed work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect/Engineer, uncover and restore work to provide for Architect/Engineers observation of concealed work.

I. Painting:

Paint all surfaces marred by cutting and/or patching to match existing.

1. Engage experienced painters.
2. Comply with requirements of Painting Sections of the Specification.

J. Structural Limitations:

1. Do not cut or drill into structural framing, walls, floors, decks, and other members intended to withstand stress, except with Engineer's written authorization.
   a. Provide lintels, columns, braces and other temporary and permanent supports made by cutting.
   b. Submit shop drawings of permanent supports.
   c. Do not penetrate legs of structural "T's" or any other location where pre-stressed structural chords are likely to be encountered when cutting or drilling.

K. Provide inspection via metal detector or x-ray to identify existing concealed utilities when existing conditions make it apparent that concealed utilities may exist.

3.2 ACCESS PANELS

A. Furnish access panels where indicated and at locations where required for access to:

1. Concealed valves
2. Dampers
3. Control devices
4. Equipment servicing
5. Shock arresters
6. Air vents
7. Flow measuring and balancing stations

8. Any other device or item equipment requiring maintenance, adjustment or service.

B. Deliver access panels for installation by the trade responsible for surface in which installed.

1. Provide instructions for location.
2. The minimum size for access doors shall be the larger of 24”x24” or to fit the size of equipment to be removed.
3. If calculation of required access doors under item A above identifies less than 1 access door per 200 square feet of ceiling and wall construction, the quantity of access doors shall be increased to 1 per 200 square feet of ceiling and wall construction.

C. See “mechanical and electrical coordination” for additional access door requirements if section has been included in this specification.

3.3 SLEEVES

A. Provide sleeves for piping passing through walls, floors and roofs.

B. Provide sleeves for existing-to-remain piping through new walls.

C. Set pipe sleeves and inserts in place before concrete is poured. Coordinate the placing of these items to avoid delaying concrete placing operations.

D. Locate chases, shafts, and openings required for the installation of the mechanical work during framing of the structure. Do any additional cutting and boring required due to improperly located or omitted openings without cost to the Owner under the supervision of the Owner’s representative.

E. Size sleeves for below grade pipe a minimum of 2” beyond outside of pipe.

F. Coat surface of all sleeves in contact with concrete, masonry or soil with two coats of coal tar bitumastic paint.

G. Provide Sleeves as Follows:

Sleeve Location	Sleeve Material
Interior Stud Partition Walls	Adjustable galvanized sheet metal with wall flanges and plaster lip, 2” and smaller – 22 gauge, 3” through 6” – 20 gauge, 8” and larger – 18 gauge.
Membrane Waterproof Floor and Roof Construction	Galvanized cast iron body with flashing clamp, threaded for sleeve riser. (J.R. Smith 1760 or equivalent by Ancon, Zurn or Josam).
Nonmembrane Floor, Construction	Non-adjustable galvanized sheet metal with deck flange and end cap, 2” and smaller – 22 gauge, 3” – 20 gauge, 4” and larger – 16 gauge.

Sleeve Location	Sleeve Material
Exterior Walls Below Grade	Standard weight galvanized steel pipe with a continuously welded water stop of ¼" steel plate extending from outside of sleeve a minimum of 2" all around. Provide modular mechanical–type seal consisting of interlocking synthetic rubber links with bolts shaped to continuously fill the annular space between the pipe and sleeve. Thunderline Corporation "Link-Seal" sealant assembly or equal by Metraflex "MetaSeal".
Floors of Mechanical Rooms, Concrete Walls or Masonry Walls Above Grade.	Standard weight galvanized steel pipe.

H. Length of Sleeves as Follows:

Location	Sleeve Length
Floors	Equal to depth of floor construction including finish. Extend minimum of 1" above finished floor level within partitions, mechanical rooms, pipe chases and finished areas.
Roofs	Equal to depth of roof construction including insulation. Extend to 2" above maximum flood depth where rooftop retention is provided.
Walls	Equal to depth of construction.

3.4 FIRE STOPPING

A. Install firestopping materials in accordance with their UL and ASTM tested methods.

B. Coordinate required annular space with size of pipe and sleeve.

C. Requirements for specific systems:

1. Cold piping - includes chilled water, domestic water, storm water and refrigerant: Insulation and vapor barrier shall be continued through wall and firestopping for "insulated piping" shall be provided.
2. Hot piping - to 250ºF -includes domestic hot water, steam to 15 psig and heating hot water: The Contractor has the option of continuing the insulation through the penetration and providing firestopping for "insulated piping", or stopping the insulation on either side of the penetration and using firestopping for "uninsulated piping".
3. High temperature piping, over 250ºF or over 15 psig steam: Contractor shall stop insulation and provide firestopping for high temperature piping.

3.5 EQUIPMENT BASES AND SUPPORTS

A. Supporting Steel: Provide supporting steel not indicated on the Structural Drawings for equipment, pipe ductwork, and other pieces of this Division's work requiring same.

1. Submit shop drawings and structural calculations to the Engineer for information and records.
2. Brace and fasten with flanges bolted to structure.
3. Paint supporting steel with one coat of primer paint in the shop after fabrication welding is complete. Paint completed field joints with one coat of matching primer.

B. Housekeeping Bases:

1. Concrete bases for pumps, boilers, tanks, fans, etc., including anchor bolts and inserts, will be provided in accordance with American Concrete Institute (ACI) and American Society for Testing and Materials (ASTM) Standards for housekeeping pads and equipment support bases.
2. The concrete shall be placed in accordance with setting diagrams and sizes furnished by the equipment installer.
3. The Section furnishing the equipment shall provide not less than 4" high concrete bases for all pumps, refrigeration machines, compressors, and rotating machinery. Bases shall extend six inches beyond machinery base in all directions, with top edge chamfered. Provide 1/2" x 6" steel dowels into floor to anchor bases. Provide anchor bolts set in pipe sleeves, two sizes larger than anchor bolts for securing machinery. After anchor bolts are aligned with equipment bases, fill sleeves with concrete and allow to set.

3.6 RAILINGS

A. Where railings and guards are not provided in another section of the specification, each contractor shall provide protection as described below for all equipment installed by the contractor.

1. Guards shall be provided where appliances, equipment, fans or other components that require service are located within 10 feet of a roof edge or open side of a walking surface and such edge or open side is located more than 30 inches above the floor, roof, or grade below.
2. The guard shall extend not less than 30 inches beyond the end of such appliance, equipment, fan or component.
3. The top of the guard shall be located not less than 42 inches above the elevated surface.
4. The guard shall be constructed so as to prevent the passage of a 21-inch-diameter sphere and shall comply with the loading requirements for guards specified in the local Building Code.

3.7 DRIP PANS

A. Drip Pans:

Where possible to run mechanical piping elsewhere, do not run mechanical piping directly above electrical (or electronic) work which is sensitive to moisture. Otherwise, provide drip pans under mechanical piping, sufficient to protect electrical work from dripping.

1. Locate pan immediately below piping, and extend a minimum of 6” on each side of piping and lengthwise 18” beyond equipment being protected.
2. Fabricate pans 2” deep of reinforced 22 gauge galvanized sheet metal with rolled edges and welded seams.

3. Provide ¾" copper drainage piping from pan to nearest floor drain or similar suitable point of discharge, and terminate pipe as an open-sight drainage connection.
4. Provide permanent support and anchorage to prevent displacement of drip pans.
5. Insulate bottom of pan where pan is subject to the frequent discharge of water or materials less than 60˚F.

END OF SECTION 230503

SECTION 230513 - MOTORS AND STARTERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data.

1. Motors: Identify by unit served. Include:
   a. Voltage
   b. Phase
   c. Horsepower
   d. Frame
   e. Insulating class
   f. Efficiency
   g. Power factor
   h. Index number
   i. Speed
   j. Starting characteristics
2. Starters: Identify by motor served. Include:
   a. Enclosure, NEMA Type
   b. NEMA size
   c. Accessories, switches, transformers, etc.
   d. Wiring diagram
   e. Auxiliary contacts
   f. Thermal overload size
3. Submit as part of packaged unit submittals when purchased as part of item of equipment.

1.2 SINGLE MANUFACTURER

A. Provide all motors, except those factory mounted, by a single manufacturer.

B. Provide all starters, except those factory mounted, by a single manufacturer.

C. "Factory mounted" means "as part of a packaged unit" where the motor is not purchased separately from the driven equipment.

PART 2 - PRODUCTS

2.1 MOTORS (OTHER THAN FACTORY MOUNTED)

A. Manufacturers:

1. Design Basis: Reliance
2. Other Acceptable Manufacturers:
   a. General Electric
   b. Westinghouse
   c. U.S. Motor
   d. Magnetek

e. Baldor
f. U.S. Electric

3. Factory mounted motors may be by equipment manufacturer's standard supplier.

B. Bearings: Ball bearings, grease lubricated with grease fittings.

C. Enclosure: As required by location.

D. Service Factor: 1.15.

E. Full-Load Operation: At 105ºF and altitude of project.

F. Overload Protection:

1. Type: Trip-free thermal overload relay.
2. Location: Each ungrounded conductor.
3. Reset: Manual.
4. Ambient Temperature Compensation: Provide where required.
5. Overload protection to be sized for nameplate running amps.

G. Insulation:

1. Constant Speed: Class B.
2. Variable Frequency Controlled: Class F.

H. Efficiency Ratings:

1. All motors one horsepower and larger, except as noted, shall be premium efficiency motors, in accordance with NEMA Standard MGI-2003, Tables 12-12 and 12-13.

I. Electrical Characteristics:

1. Refer to sections 23 05 01, Mechanical and Electrical Coordination.
2. Motors less than ½ hp shall be 115-volt single phase.
3. Motors ½ hp and larger shall be three phase, of voltage shown in Electrical Section of Contract Documents.

J. Multi-speed Motors:

1. Type: Motors may be one of the following:
   a. Two speed, two winding 1800/900 rpm.
   b. Two speed, one winding 1800/900 rpm.

K. Variable Speed Drives:

1. All motors operated by a variable speed drive shall be rated for inverter duty.
2. Motor insulation shall be rated for 1600-volt peak.
3. All motors need to be NEMA MG-1, Part 31 compliant.
4. Refer to VFD specification for additional requirements if included in this specification.

5. Provide AEGIS shaft grounding rings for all motors operated by a VFD.

2.2 MOTORS (FACTORY MOUNTED)

A. Provide premium efficiency motors.

B. Variable Speed Drives:

1. All motors operated by a variable speed drive shall be rated for inverter duty.
2. Motor insulation shall be rated for 1600 volt peak.
3. All motors need to be NEMA MG-1, Part 31 compliant.
4. Refer to VFD specification for additional requirements if included in this specification.
5. Provide shaft grounding rings for all motors operated by a VFD.

2.3 STARTERS

A. Manufacturers:

1. Allen Bradley
2. Cutler-Hammer
3. General Electric
4. Square D

B. General:

1. Starters shall be standard NEMA sizes and UL listed.

C. Type: Across the line except where noted.

D. Enclosure: NEMA Type as required for location. Provide stainless steel enclosures in wash down areas, kitchens, dishwasher areas, exterior spaces, and any other areas where equipment will be exposed to moisture. Provide space heater and any necessary transformer within the enclosure as required to maintain the minimum internal temperature required by the manufacturer.

E. Overload Protection:

1. Type: Trip-free thermal overload relay for each ungrounded conductor.
2. Reset: Manual.
3. Ambient Temperature Compensation: Provide where required.
4. Overload protection to be sized for nameplate running amps.

F. Auxiliary Contacts:

1. Number: Provide three per starter as required for control sequence, and one (1) auxiliary contact.
2. Switchable type, easily changed from N.O. to N.C. without removing from its mounting.

G. Switches in Cover:

1. Manually Controlled: Three wire start-stop.

2. Automatically Controlled: Hand-off-automatic.
3. Start and stop indicating lights.
4. Equipment used for life safety (smoke exhaust, etc.): Hand-Automatic.
5. Equipment not designed to run continuously: Off-Automatic.

H. Control Transformer:

1. Provide when line voltage exceeds 208 volts.
2. Secondary wiring shall have one leg fused and the other grounded.
3. Secondary voltage not to exceed 120 volts.

I. Provide starters for all motors as follows:

1. Single phase motors less than ½ hp.
   a. With internal overload protection: None.
   b. Without internal overload protection:
      1) Manually Controlled: Manual starter.
      2) Automatically Controlled: Magnetic starter.
2. Single phase motors ½ hp and larger:
   a. Manually Controlled: Manual starter.
   b. Automatically Controlled: Magnetic starter.
3. Three Phase Motors: Magnetic starter.

J. Soft Start Starters:

1. Provide Y-Delta or solid state reduced voltage starters for all motors 50hp and larger.
2. Starter shall limit starting voltage to 200% of full load voltage.

K. Multi-Speed Starters:

1. Starters shall be suitable for the type multi-speed motor selected.
2. Provide time delay for automatic transfer from high to low speed.

L. Housing coils to be 120V.

M. Motor Protection: (above 20 hp)

1. Provide Single-phase protection.
2. Provide under-voltage protection.

N. Disconnecting Means

1. Provide combination starters-disconnects for all starters unless specifically stated otherwise.

PART 3 - EXECUTION

3.1 MOTORS

A. Install motors on motor mounting systems so coupling or belt drive is properly aligned. Provide proper belt tension. Dowel direct coupled motors.

B. Field quality control: Fun each motor to demonstrate rotation, speed, current draw meets nameplate, etc.

C. Requirements for storage, handling and protection: Keep motor windings protected and clear of dust.

3.2 STARTERS

A. Deliver to installer of electrical work.

B. All safety devices shall be wired so that they will stop the motor with a hand-off-automatic switch in the hand as well as the automatic position.

END OF SECTION 230513

SECTION 230523 - VALVES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data including:

1. Dimensions
2. Sizes
3. End Connections
4. Weights
5. Installation instructions
6. Instructions on repacking and repairing valves.
7. Range of flow for balancing valves and plug valves.

B. Valve Tag List: See requirements in this Specification.

PART 2 - PRODUCTS

2.1 GENERAL

A. In addition to valves specified herein, provide products meeting the pressure requirements of the system.

B. Where type or body material is not indicated, provide valve with pressure class selected from MSS or ANSI standards, based on the maximum pressure and temperature in the piping system. Valve body material shall be coordinated with the piping system material.

C. Except for balancing or otherwise indicated, provide valve of same size as connecting pipe size.

D. All valves shall be gate valves. If ball, butterfly, globe, plug, or balancing valves are called out by note or symbol, only that type of valve is acceptable.

E. Ball valves or butterfly valves may be used in lieu of gate valves in non-balancing applications when pressure and temperature ratings are adequate.

F. Where pipe sizes overlap, contractor has the option of threaded or flanged valves.

G. Where grooved pipe mechanical coupling systems are accepted, provide flange adapters to mate with valves as specified below. Valves manufactured by the mechanical coupling system manufacturer shall not be used unless they meet all of the specified requirements for a given valve and are of the same manufacturer as the adjoining couplings.

H. All valves shall be domestically manufactured unless approved for use by Engineer.

I. All components in hydronic systems shall be compatible with propylene glycol and water solution.

J. All valves shall be of a design which the manufacturer lists for the service and shall be of materials allowed by the latest edition of the ASME Code for pressure piping for the pressure and temperature contemplated, unless a higher grade or quality is herein specified.

K. Valve packing compression is to be independent of the stem, ball or handle systems. All valve stems are to be blowout proof. Packing shall be accessible without disturbing the insulation.

L. All valves used for vent or drain service on water systems shall have a brass hose connection with cap and chain.

M. Unless otherwise noted, all valves for shut-off and bypass service shall be ball valves, 2" and below, and butterfly valves 2-1/2" and above. Ball valves are acceptable in 2-1/2" and 3" copper only.

N. End connections for NPS 2” and below shall be the same as is used for fittings. Use flanged valves for NPS two and one half inches (2-1/2") and above. Solder joints are also acceptable in 2-1/2" and 3" copper piping systems.

O. Install valves after welding adjacent to valve is completed to protect seat and disk.

P. All valves used for vent or drain service on water systems shall have a brass hose connection with cap and chain.

Q. Non-electric radiator control valves with valve mounted heads are not acceptable, except on cast iron radiators, where they shall be side mounted. Where used, thermostatic radiator valves shall be remote bulb and remote control head design. The control head shall be mounted on the radiation enclosure, if possible.

2.2 GLOBE VALVES (Water, Oil, Gas)

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Crane
   b. Nibco
   c. Powell
   d. Gruvlok
   e. Stockham

2” AND SMALLER	UNDER 300 PSI	Milwaukee Model 591A Bronze, 150 SWP at 406 deg. F., 300 WOG at 150 deg. F., Non-Shock, Heavy Duty Service, Special Hardened Stainless Steel Seat Ring and Disc, Union Bonnet, Gland Packed, Threaded Ends
2 ½” AND LARGER	UNDER 200 PSI	Milwaukee Model F-2981 Iron, 125 SWP, 200 WOG, Non-Shock, Solid Disc, Bolted Bonnet, Gland Packed, Flanged Ends
	OVER 200 PSI	Milwaukee Model F-2983 Iron, 250 SWP, 500 WOG, Non-Shock, Solid Disc, Bolted Bonnet, Gland Packed, Flanged Ends.

3" AND SMALLER (for use with copper tubing)	UNDER 300 PSI	Milwaukee Model 590T Bronze, 150 SWP, 300 WOG, Heavy Duty Service, Teflon Disc, Union Bonnet, Gland Packed

2.3 GLOBE VALVES (Steam)

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Crane
   b. Nibco
   c. Stockham
   d. Hammond
   e. Gruvlok

2" AND SMALLER	UNDER 300 PSI	Milwaukee Model No. 593A Bronze, 300 lb. WSP, Threaded
2 ½" AND LARGER	UNDER 250 PSI	Milwaukee Model F2983 Iron body, 250 lb. WSP, OS&Y, Flanged ends - Bronze Trim

2.4 ANGLE VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Crane
   b. Nibco
   c. Stockham
   d. Hammond
   e. Gruvlok

2" AND SMALLER	UNDER 300 PSI	Milwaukee Model 595T Bronze Body, 150 WSP, 300 WOG, Threaded, Union Bonnet, Angle Bronze Disc

2.5 REFRIGERANT VALVES

A. All refrigerant valves shall be silver brazed joint as follows:

1. Globe Valves – 1-1/8" O.D. and smaller: packless, Henry type 626; 1-3/8" O.D. and larger: packed, wing cap, Henry type 203.
2. Angle Valves – 1-1/8" O.D. and smaller: packless, Henry type 647 and 642; 1-3/8" O.D. and larger: packed, wing cap, Henry type 216.

3. Globe valves shall be of all bronze with composition disc, threaded or brazed joint ends as required by piping system in which they are installed.
4. All refrigerant valves shall be silver brazed joint as follows:
   a. Check Valves – 7/8" O.D. and smaller: brass, Henry type 116A; 1-1/8" O.D. and larger: bronze, Henry type 205.

2.6 SILENT/WAFER CHECK VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Metra Flex
   b. Hammond
   c. GA Industries
   d. Nibco
   e. Tyco
   f. Gruvlok
   g. Stockham

2" – 6"	UNDER 200 PSI @ 150 °F	Milwaukee Model 1400 Cast Iron body, Bronze trim, Center guided single disc, 200 PSI rating.

B. Hydronic piping system grooved end spring-loaded check valves shall be suitable for pressures up to 365 psi and operating temperatures up to 230 deg F.

1. 2" through 3": Ductile iron body, stainless steel disc and spring, nickel-plated seat, 365 psi CWP.
2. 4" through 6": Ductile iron body, EPDM coated ductile iron disc, stainless steel spring and shaft, welded-in nickel seat, 300 psi CWP.

2.7 SWING CHECK VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers;
   a. Crane
   b. Nibco
   c. Hammond
   d. Stockham
   e. Victaulic (for Grooved Pipe Systems)
   f. Gruvlok

2” and Smaller	Under 400 PSI	Milwaukee Model 508 Bronze body, 200 PSI SWP, 400 PSI WOG, Straight through pattern, bronze disc
2½” and Larger	Under 200 PSI	Milwaukee Model F2974 Iron Body, 125 PSI SWP, 200 PSI WOG, bolted cap

B. Hydronic piping system grooved end horizontal swing check valves shall be suitable for pressures up to 300 psi and operating temperatures up to 230 deg F. Ductile iron body, type 316 stainless steel clapper, EPDM seat.

C. High-Pressure Steam and Condensate and parts of fuel oil system subjected to pressures greater than 75 lbs. and for medium-temperature hot water service.

1. Check Valve: 2” and smaller, Milwaukee 507, 300 lb. WSP, bronze. 2½” and larger: Milwaukee F2970, 250 lb. WSP, iron body.
2. Swing Check: 2” and smaller: Milwaukee 509, 125 lb. WSP, bronze. 3” & smaller: 300 lb. Nonshock CW bronze with solder joint adapter.

D. Two inches (2") and under: 45˚ swing check, screwed end.

E. Two and one half inches (2 1/2") and over: Non-slam type globe style lift check, non-slam type tilting disc or wafer body non-slam type lift check. Double disc or bi-folding disc type valves are not acceptable.

2.8 BUTTERFLY VALVES (Water, Oil, Gas)

A. Manufacturers:

1. Design Basis: Bray
2. Other Acceptable Manufacturers:
   a. Jamesbury

½” – 2”	USE BALL VALVE	
2 ½” – 12”	UNDER 250 PSI	Bray Model 40/41 Carbon Steel, 17-4 PH Stainless Steel stem, 316 stainless steel disc

B. Butterfly valves in size 2 ½" - 20" shall be of the single flange, lug body style. Bodies shall be carbon steel. Valves shall provide drip-tight shutoff at differentials up to 300 psi.

C. Lug body valves shall have a retained seat and shall provide tight shutoff up to the full valve rating on dead end or isolation service without the use of downstream flanges.

D. All valves shall be furnished with self lubricated bearings of TFE coated stainless steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

E. Body:

1. Shall be one-piece wafer, lug or double flanged design with extended neck to allow for 2” of piping insulation.
2. Flange hole drilling per international flange standard as specified.
3. Provided with top and bottom stem bearings consisting of a 316 stainless steel shell with a TFE/glass fabric liner bearing surface.
4. Equipped with an externally adjustable stem packing system that allows packing adjustment without removing the actuator.
5. Internal over-travel stop shall be provided to prevent over-travel of the disc and minimize possible seat damage.

F. Seats:

1. Design shall consist of a resilient energizer totally encapsulated by the seat.
2. Seat retainer shall be full-faced and firmly attached by bolts located outside the sealing area to protect them from corrosion.
3. The seat assembly shall be locked in the body recess by the full-faced retainer.
4. The seat shall be self-adjusting for wear and temperature changes.
5. The seat shall be easily field replaceable.

G. Stem:

1. Shall be one-piece design
2. Stem shall be provided with blow-out proof stem retention system to assure full retention of the stem in the unlikely event of an internal stem failure.
3. Disc-to-stem connection shall be an internal connection design with no possible leak paths in the disc-to-stem connection. External disc-to-stem connections such as disc screws or pins are not allowed.
4. Stem shall be provided with blow-out proof stem retention system to assure full retention of the stem in the unlikely event of an internal stem failure.

H. Disc edge shall be hand polished for minimum torque and maximum sealing capability.

I. Valve shall be tested for tight shut-off per API 598 requirements.

J. Latch lock levers shall provide automatic, positive latching in the open, closed or eight intermediate positions. These valves shall allow locking in any position with a standard padlock. Infinite position levers shall allow manual throttling and locking in any position from open to close. External disc position indicators shall be provided.

K. All manually actuated valves 8" and larger shall be operated using a cast iron housed handwheel actuator available in standard, weatherproof, or buriable constructions - as required - with optional chainwheel, crank, or 2" square nut input. All units to have adjustable open and closed position stops with provision to prevent accidental adjustment changes. Operating shaft to be supported axially and radially at input end by permanently lubricated bronze thrust and sleeve bearings.

L. Butterfly valves equipped with gear or automatic operators shall have operator factory mounted and the stops factory adjusted. Loose gear operators shall not be permitted to be installed in the

field. Gear operators on steam valves shall be spaced a minimum of 4” above packing assembly.

M. All automatic butterfly valves intended for exterior use shall be furnished with and wired for crankcase heaters.

2.9 BUTTERFLY VALVES (STEAM)

A. Provide high performance butterfly valve suitable for maximum operating pressure.

2” - 20”	UNDER 300 PSI	Milwaukee HP1LCS4212/4213 and HP3LCS4212/4213 Suitable for mating between Class 150/300 flanges (flat or raised face). Conforms to MSS SP68.

B. Body: Carbon Steel

C. Body Style: Tapped Lug (full flange)

D. Trim: 316 Stainless Steel Double Offset Stem

E. Disc: 316 Stainless Steel

F. Seat: High temperature RTFE, fully bi-directional, dead-endable

G. Seat Working P/T Rating: 100 psig @ 450˚F Minimum

H. Body Working P/T Rating: ANSI 150

I. Actuator: Handwheel Gear Operator

J. Provide external disc position indicators.

2.10 GATE VALVES (Water, Oil, Gas)

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Crane
   b. Nibco
   c. Stockham
   d. Gruvlok
   e. Hammond

2” AND SMALLER	UNDER 400 PSI	Milwaukee Model 1151/1182 Bronze Gate Valve, 300/1000 PSI WOG Non-Shock, Heavy Duty Service, Solid Wedge Disc, Rising Stem, Stainless Seat, Union Bonnet, Threaded Ends

2 ½" AND LARGER	UNDER 200 PSI	Milwaukee Model F-2885 Cast Iron Body, 125 PSI Fluid Pressure to 450 deg. F. 200 PSI Non-Shock Cold Water, Oil or Gas. -200 deg. F. to 150 deg. F, or -29 deg. C to 66 deg. C, Bronze Trim, OS & Y, Bolted Bonnet, Solid Wedge, Flanged Ends

B. Gate valves shall not be used for refrigerant systems.

C. All gate valves within the building shall be wedge gate valves with painted iron wheels handles, shall have gland followers in stuffing boxes, and shall be constructed that they may be repacked while open and under pressure. All valves shall have the name of the manufacturer and working pressure cast or stamped thereon.

D. Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.

2.11 GATE VALVES (Steam)

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Crane
   b. Nibco
   c. Stockham
   d. Victaulic (for Grooved Pipe Systems)
   e. Gruvlok
   f. Hammond

2" AND SMALLER	UNDER 200 PSI	Milwaukee Model 115/1182 Bronze Gate Valve, 300/1000 PSI WOG Non-Shock, Heavy Duty Service, Solid Wedge Disc, Rising Stem, Stainless Seat, Union Bonnet, Threaded Ends
2 ½" AND LARGER	UNDER 125 PSI	Milwaukee Model F-2885 Cast Iron Body, 125 PSI Fluid Pressure to 450 deg. F, Stainless Steel Trim, OS & Y, Bolted Bonnet, Solid Wedge, Flanged Ends

2.12 BALL VALVES (Water, Oil, Gas*, Low Pressure Steam, Low Pressure Condensate)*

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:

   a. Apollo
   b. Dyna Quip
   c. Hammond

d. Watts
e. Bray
f. Gruvlok
g. Stockham

3" and above	UNDER 300 PSI	Milwaukee BA400 Bronze body, Threaded, Full Port, SST Trim, Blowout-Proof Stem, 300 lb. WOG 150 PSI Non-Shock Cold Working Pressure, 150 PSI/Saturated Steam. Conforms to MSS SP-110 Reinforced Teflon seat
2½" and below	UNDER 300 PSI	Bronze body, standard port, 316 SST ball, 316 SST stem, Stem extension for insulated applications, RTFE seat, 15% glass filled double seal, Seat working rating 300 PSIG, 250°F minimum, Body working rating 300 PSIG 300°F minimum. 300 PSI WOG. 150 PSI steam

B. Provide the following where required:

1. Extended stems for insulated valves.
2. Memory stop device for balancing applications.
3. Tee handle for tighter areas.
4. Hose end and cap for drain.
5. Mounting pads for actuator.
6. Provide "stop and drain" for compressed air.

2.13 BALANCING VALVES

A. Manufacturer, variable orifice type circuit setter:

1. Armstrong
2. Victaulic/Tour and Andersson
3. Nibco
4. Oventrop

2" AND SMALLER	UNDER 300 PSI	Armstrong CBV-VS/VT Brass alloy body/stem and disk, 300 PSI Max. Working Pressure, -4°F to 300°F Operating Temperature Range, Threaded or Solder Connections Victaulic/Tour & Andersson Series 786, 787, 78K A metal brass copper alloy body, EPDM o-rings, 4-turn digital hand wheel for balancing, soldered or threaded end connections, 250°F temperature rating.
2 ½" AND LARGER	UNDER 125 PSI	Armstrong CBV-FS/FA 125 PSI rating, Cast Iron valve body, Bronze disc, Brass stem, Stainless Steel spring, Straight or Angle

B. Manufacturers, valve and venturi type:
1. Flowset

2. Gerand
3. Griswold
4. HCI
5. Nexus
6. Oventrop
7. Preso

C. Connections: Threaded, soldered, grooved, or flanged.

D. Pressure Reading Ports:

1. “P/T” Ports, Shraeder valves, or Hansen type quick connect. No “refrigeration” fittings.

E. Design, variable orifice type:

1. Globe-type valve.
2. Multiple turns of handwheel from full closed to full open.
3. Bubble-tight shut-off.
4. Taps upstream and downstream.
5. Memory stop device to allow valve to be returned to balanced position after being closed.

F. Design, valve and venturi type:

1. Ball valve complying with the above requirements for ball valves.
2. Fixed orifice or venturi, upstream of valve.
3. Taps on venturi, upstream and downstream.
4. Memory stop device to allow valve to be returned to balanced position after being closed.
5. Regardless of the manufacturer’s claims, these valves shall not be considered as tight shut off for service. Provide additional valves for equipment isolation.

G. Insulation: Provide premolded insulation conforming to the valve body. Material shall have a flame spread of 25 and a smoke development of 50.

H. Where application or building height causes working pressure to exceed 150 psi. Provide 2” and smaller: Crane No. 80E, 250 lb. WSP, bronze; 2 ½” and larger: use globe.

I. Balancing Cocks: Up to 2”

1. Bronze.
2. Screwed 120 psi WSP Class; similar to Fig. 554.
3. 250 psi WSP Class; similar to Fig. 576.

J. Balancing Cocks 2½ and 3”

1. Iron body similar to Walworth Co.
2. Screwed.
3. 120 psi WSP Class; similar to Fig. 651.
4. 250 psi WSP Class; similar to Fig. 671.

K. Balancing cocks 4” and above

1. Provide flanged lubricated plug valve.

2.14 DRAIN VALVES

A. Gate or ball valve with hose end adapter and cap. Milwaukee BA100H or approved equal.

B. Drain valves: 2” and smaller: Crane No. 451, 300 lb. WOG, non-rising stem, Hose end, bronze with bronze cap and chain.

C. Where application or building height cause working pressure to exceed 150 psi provide Crane No. 453, 300 lb. WOG, non-rising stem, hose for valves 2” and smaller.

2.15 PLUG VALVES

A. Manufacturers:

1. Design Basis: Homestead
2. Other Acceptable Manufacturers:
   a. DeZURIK
   b. Victaulic (For grooved pipe systems)

B. Model: Series 600 (ANSI class 125) cast-iron, full port body; EPDM coated plug; welded nickel seat; stainless steel bearings; integral memory stop device.

C. Lubricated Plug Valves:

1. Full port opening tapered plug suitable for lubrication under service pressure with plug in any direction.

2. Lubricating Guns:
   a. One for every 10 valves.
   b. Extra heavy, lever type, hydraulic hand gun.
   c. 15,000 psi gauge and 12" long connection hose.
   d. Similar to Walworth #1699 or approved equal.

3. Lubricant:
   a. Manufacturer's recommendations.
   b. One year supply, each valve.

4. Operators:
   a. 4" to 6", wrench, except as noted. Provide wrench set for each size valve, one wrench for every 10 valves, each size.

5. Valve Construction

   a. Piping less than 100 psi: 200# WOG Class, cast iron body.
   b. Piping 100 psi to 250 psi: 500# WOG Class, cast iron body.
   c. Piping over 250 psi: 720# WOG Class, carbon steel body.
   d. Up to 2": screwed. 2½ " and larger: flanged, USAS 250#.
   e. Similar to the following Walworth figure numbers:

Class	4"
200#	1700F
500#	2720F
720#	1760F

6. In lieu of lubricated plug valves use DeZURIK BOS-US for piping up to 250 psi. For piping above 275 psi use DeZURIK BHP high performance butterfly valve.

D. Non-Lubricated, Eccentric Type Plug Valves:

1. 175 psi CWP, ductile iron body and plug, EPDM plug coating, welded-in nickel seat, grooved ends, lever handle or gear operator with hand wheel. Victaulic Series 377.

PART 3 - EXECUTION

3.1 GENERAL

A. Furnish all valves as indicated on the plans, and as may be required for the proper control of the pipe lines installed under this Specification, so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the Building.

B. Install valves where required for proper operation of piping and equipment including valves in branch lines necessary to isolate sections of piping. Whether they are shown on the drawings or not, provide isolation valves at the following locations:

1. All branch piping connections to risers
2. All branch piping connections to piping mains
3. Branch piping at each mechanical room
4. Each piece of equipment, fixture, and appliance so that the supply and return services can be shut off to remove the item without draining the remainder of the piping system

C. Provide drain valves at main shut-off valves, all low points of piping and apparatus.

D. Install check and globe valves on downstream side of the shutoff valve on hot water circulating riser and branch lines.

E. Provide shut-off valves and check valves on each pump discharge line.

F. Locate all valves so as to be accessible.

G. All valves shall be installed as per manufacturer’s recommendations.

H. Combination balancing and shut-off valves may be used instead of a separate balancing valve and shut-off valve if the valve has a memory stop and the manufacturer lists its use as a leak-proof service valve

I. Valves, where exposed and used in connection with finished piping, shall be same finish as the pipe.

J. Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.

K. Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves where corrosion is indicated or can be expected to occur.

L. Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

M. Select and install valves with renewable seats, except where otherwise indicated.

N. All valves shall have the trademark of the manufacturer and the guaranteed working pressure cast or stamped on the body of the valve.

O. Provide separate support for weight of valve where necessary.

P. Install all valves except butterfly with stems pointing up, and as close to vertical as possible. Butterfly valves to be offset at least 10° from vertical. All steam butterfly valves shall be installed at least 30° off vertical to protect the bottom bearing from debris. Do not allow meter connections of balancing valves to point downward.

Q. Except as otherwise indicated, install gate, ball, globe, and butterfly valves to comply with ANSI B31.1.

R. All valves of a given type shall be of one manufacturer.

S. Provide extended stems on insulated system to prevent interference of operator with insulation.

T. Provide chain wheel operators for valves more than 7’ – 0” AFF in mechanical rooms and wherever shown on drawings.

U. Provide ball valves for shut-off on all pressure gauges at the gauge and separate 1/2" (one half inch) ball valves for the various taps to the gauge on a manifold gauge.

3.2 CHECK VALVE INSTALLATION

A. Swing and Check Valves:

1. Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.
2. Do not install in pump discharge piping.

B. Silent Check Valves:

1. Silent check valves may be installed in vertical pipes with flow down upon Engineer’s review for each instance.

C. Installation of Check Valves:

1. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position.
2. Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward.
3. Vertical Lift Check Valve: Install in vertical piping line with upward flow with stem vertically upward.
4. Spring Loaded Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward.

3.3 VALVES USED FOR THROTTLING/BALANCING

A. Balancing valves shall not be used for flow indication in pipes 2½" and larger, or in pump discharge piping.

B. Flow indication in piping 2½" and larger and in pump discharge piping, shall be by a venturi with a plug, butterfly, or globe valve for throttling.

C. Throttling/Balancing Valves shall be selected so that the maximum design flow causes between 1' and 10' W.G. pressure drop or meter reading with the valve wide open.

D. Install balancing valves (excluding flow limiters) used for flow indication with a minimum of ten times pipe diameters downstream of a pump, five times the pipe diameter downstream and two times the pipe diameter upstream of a fitting or valve, unless otherwise specified by the valve manufacturer.

E. Circuit setters or plug valves may be used for throttling/balancing. Provide an infinitely variable, lockable memory stop device to allow the valve to be returned to the "balanced" position after closing, and to prevent movement of the disk or plug during operation. When ball valves are used for throttling, provide an additional valve for equipment isolation.

END OF SECTION 230523

SECTION 230529 - PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 STANDARDS

A. Comply with MSS Standard Practice SP-58, SP-69 and SP-89, published by Manufacturer's Standardization Society of the Valve and Fitting Industry for type and size.

1.2 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Hangers other than clevis type.
2. Anchors.

B. Submit structural calculations for trapeze type supports.

PART 2 – PRODUCTS

2.1 PIPE HANGERS

A. General:

1. Use adjustable pipe hangers on suspended pipe. Trapeze hangers may be used at the Contractor's option. Contractor shall be responsible for sizing supports.
2. Chain, wire or perforated strap hangers will not be permitted.
3. Isolate hangers in contact with dissimilar materials with dielectric hanger liners. Tape is not acceptable.
4. Provide supports between piping and building structure where necessary to prevent swaying.

B. Hanger Rods:

1. Exposed in public areas: Zinc electroplated steel.
2. Concealed or in service areas: Black threaded steel.
3. Outside, exposed to weather: Hot dipped galvanized.

C. Spot Concrete Inserts: Steel case and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

1. Size inserts to match size of threaded hanger rods.
2. Inserts to be UL and FM listed.
3. Minimum 1000 lb. Capacity with ½" rod.

D. Channel Type Inserts:

1. Standard channel support with anchor tabs on 4" centers, and nail holes for attaching to forms.

2. Styrofoam inserts to prevent wet concrete seepage.
3. Minimum 2000 pounds/foot capacity.

E. Expansion Anchors:

1. For use only in renovations or where modifications to piping layouts require installation away from pre-installed insert locations.
2. Inserts shall be of the drill, insert, and expand type. Power driven fasteners are not acceptable for piping.
3. Contractor shall select the appropriate type based on the following:

Rod Size	Maximum Working Load
3/8	600 pounds
½	1100 pounds
5/8	1800 pounds

F. Steel Structure Attachments:

1. Contractor may select welded or mechanically attached. All mechanically attached supports shall have jam nuts or other means to prevent loosening. Maximum loading requirements are as follows:

Rod Size	Maximum Working Load
3/8	600 pounds
½	1100 pounds
5/8	1800 pounds

G. Single Hangers:

1. Piping 2” and smaller: MSS type 1, Clevis hanger or type 7 adjustable swivel ring hanger. Minimum 180 pounds design load.
2. Piping 2” and smaller (steel): Clevis hanger, Anvil Fig. No. 260, F & M Fig. No. 239, Paterson Fig. No. 100.
3. Piping 2” and smaller (copper): Adjustable wrought iron, Anvil Fig. No. CT-65, F & M Fig. No. 364, Paterson Fig. No. 100 CT
4. Piping 2½” and larger: MSS type 1 Clevis hanger.
5. Piping 2½” to 4” (steel): Adjustable swivel pipe roll, Anvil Fig. No. 181, F & M Fig. No. 2729, Paterson Fig. No., 16.
6. Piping 2½” to 4” (copper): Adjustable wrought ring, Anvil Fig. No. CT-69.
7. Bare copper pipe: Above hangers, plastic or Neoprene coating, sized for copper pipe O.D. and copper coated for identification.
8. Insulated pipe: Hangers to be sized for O.D. of insulation. Hangers shall not penetrate any insulation.
9. Cast iron pipe above hangers sized for O.D. of cast iron pipe.
10. Hanger wire, cable or perforated metal strapping are not acceptable.

H. Trapeze hangers and wall supports:

1. Channel strut or structural steel shapes. Contractor shall follow channel strut manufacturers guidelines for loading or provide structural steel supports designed by a professional Engineer, licensed in the state where the project is located.

2. All piping shall be attached to the support by means of a channel strut clamp, U-bolt, or pipe rollers which will maintain lateral position of the pipe but allow longitudinal movement. Provide dielectric isolation between all dissimilar metals.
3. All insulation shall be continuous at supports. Do not notch or penetrate insulation or vapor barrier.
4. Kindorf or similar materials used for support of small piping shall not be used for piping 3" or larger.
5. ½" through 3": Unistrut type channel and steel clamp.
   a. Use Hydrosorb cushions on copper pipe.

I. Vertical Supports: Provide steel riser clamp at each floor penetration or every 14 foot supported from wall bracket. Do not anchor riser clamps.

J. Hangers:

1. General: Adjustable wrought steel clevis with locking nut attachment.
2. Multiple or Trapeze: Steel channels with welded spacers and hanger rods.
3. Hanger Sizes and Spacing:
   a. For drain piping, conform to the code requirements for spacing, and the following table for hanger rod sizes.
   b. For steam and hydronic piping, conform to the following table:

PIPE TYPE	PIPE SIZE	MAXIMUM HORIZONTAL SPACING	MAXIMUM VERTICAL SPACING	MINIMUM HANGER ROD SIZE
Steel and Stainless Steel Pipe	½"	6'-0"	15'-0"	3/8"
	¾" thru 1¼"	8'-0"	15'-0"	3/8"
	1½" and 2"	10'-0"	15'-0"	3/8"
	2½" thru 3½"	12'-0"	15'-0"	½"
	4" and 5"	12'-0"	15'-0"	5/8"
Copper Pipe	½" thru 1"	8'-0"	10'-0"	3/8"
	1¼" thru 2"	10'-0"	10'-0"	3/8"
	2½" thru 3"	10'-0"	10'-0"	½"
Copper Tubing	1¼ " and below	6'-0"	10'-0"	3/8"

* Submit routing and support plans to Architect/Engineer for review.

K. Insulated Pipe Supports:

1. Size pipe supports for outside diameter of pipe insulation.
2. It is not acceptable to notch insulation or vapor barrier at supports.

L. Pipes over five inches and over 120ºF: Provide cast iron roller supports.

M. Beam clamps - Hangers supported from floor steel shall be approved I beam clamps. I beam clamps for hangers supporting piping 2 inches and smaller shall be C & P Fig. No. 148

adjustable beam clamps. For piping 2-1/2 inches and larger, I beam clamps shall be wrought steel. C & P Fig. No. 268 or equal.

N. Hangers for copper piping shall be copper plated.

2.2 INSULATION INSERTS

A. Pipe shall be protected at the point of support by an insert of high density, foam glass insulation, encased in a sheet metal shield. Insert to be same thickness as adjoining pipe insulation. Insulation insert to extend one inch beyond sheet metal shield on all “cold” lines. If pipe hanger spacing exceeds ten feet and for all pipe roller applications, utilize double layer shield on bearing surface.

B. Provide 180º insulation inserts when utilizing clevis hangers. Provide 360º insulation inserts at all trapeze and wall supports.

2.3 PIPE ANCHORS

A. Manufacturers:

1. Design Basis: Flexonics
2. Other Acceptable Manufacturers:
   a. Adsco
   b. Keflex
   c. Hilti

B. Model AC with threaded ends and welded angle brackets for steel pipe.

C. Model AC copper tube with solder ends and steel angle brackets brazed to tubing for copper tube.

D. Anchors may be field fabricated similar to manufactured products specified.

2.4 PIPE GUIDES

A. Manufacturers:

1. Basis of Design: B-line.
2. Other Acceptable Manufacturers:
   a. Fee & Mason
   b. Anvil
   c. M-Co
   d. PHD

B. Any of the Following:

1. Spider Type: B3281-7.
2. Roller Type: 2 sets of roller son opposite sides of pipe.
3. Slide Type: B3893 with hold down lugs.
   a. Not for use with cold piping.

4. Light duty, 1½" and smaller copper: U bolt or channel strut clamp (B2417) allowing clearance from O.D. of pipe or insulation.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPE SUPPORTS

A. Adequately support piping from the building structure with adjustable hangers to maintain uniform grading where required and to prevent sagging and pocketing.

1. Provide supports between piping and building structure where necessary to prevent swaying.
2. Do not support pipe from other pipe or equipment.

B. Install hangers to provide minimum ½" clear space between finished covering and adjacent work.

1. Place a hanger within one foot of each horizontal elbow.
2. Space hangers generally as called for in Table in Part 2, Products.

C. Use hangers, which are vertically adjustable 1-½" minimum after piping is erected.

D. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

1. Set inserts in position in advance of concrete work.
2. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
3. Do not penetrate concrete "TT" legs for piping inserts. Do not penetrate the stressed (i.e. lower) chords of any structural member.

E. Provisions for Movement: Install hangers and supports:

1. To allow controlled movement of piping systems.
2. To permit proper movement between pipe anchors.
3. To facilitate the action of expansion joints, expansion loops, bends and offsets.
4. To isolate force due to weight or expansion from equipment connections.

F. In general, attach hangers to upper chord of roof trusses and floor joists, using long rods to facilitate pipe movement.

G. Anchors:

1. Use no pipe anchors. Arrange piping such that pipe expansion and contraction is accommodated by controlled movement of the pipe within the pipe supports. Provide sufficient offsets in branch piping to accommodate movement of main piping due to expansion and contraction. Where this is not possible due to building geometry or other reasons, securely anchor piping where indicated or where required for a proper installation and to force the pipe expansion in the proper direction.
2. Anchors shall be suitable for the location of installation and shall be designed to withstand not less than five times the anchor load.

3. Anchor vertical pipes by means of clamps welded around pipes and secured to wall or floor construction. Anchor at bottom of riser only but provide guides for vertical thermal movement.
4. All anchors shall be separate and independent of all hangers, guides, and supports. Anchors shall be of heavy blacksmith construction suitable in every way for the work approved by the Architect. Anchors shall be welded to the pipe and fastened to the structure with bolts.
5. Anchors shall be fabricated and assembled in such a form as to secure the piping in a fixed position. They shall permit the line to take up its expansion and contraction freely in opposite directions away from the anchored points: and shall be so arranged as to be structurally suitable for particular location, and line loading. Submit details for approval.

H. Assume the responsibility for the proper transfer of the loads to the piping systems to the structure. No additional cost to the owner should be expected for any corrective work during construction.

I. Provide necessary structural members, hangers, and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported from metal decking and/or concrete construction, care shall be taken not to weaken decking and/or concrete or penetrate waterproofing. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot, or chilled, as required.

J. Provide supplemental bolted steel in all locations where drilling of slab will create unacceptable noise in adjacent spaces.

K. Where piping is run near the floor and not hung from the ceiling construction but is supported from the floor, such supports shall be of pipe standards with base flange and adjustable top yoke similar to C & P Fig. 247 or equal.

L. All vertical piping shall be anchored by means of heavy steel clamps securely bolted or welded to the piping, and with end extension bearing on the building.

M. Vertical runs of pipe not over 15 feet long shall be supported by hangers placed not over one foot from the elbows on the connecting horizontal runs.

N. Vertical runs of pipe over 15 feet long but not over 60 feet long and not over 6 inches in size, or not over 30 feet long and not over 12 inches in size, shall be supported on heavy steel clamps. Clamps shall be bolted tightly around the pipes and shall reset securely on the building structure without blocking. Clamps shall be welded to the pipes or placed below couplings. Clamps shall be type 8, Federal Specification WW-H-171C, unless other types are approved.

O. For all chilled water and makeup water and insulated refrigerant piping, provide "Insulshield" as made by Insulcoustic Corp. or pipe covering protection shield F & S Fig. 980 with steel shield, with vapor barrier jacket. For steam, condensate, hot fuel oil and hot-water heating piping 2 inches and smaller, same as above. For steam, condensate and hot-water heating piping 2-1/2 inches and larger, provide steel pipe covering protection saddles F & S Fig. 900 series. Sized to fit insulation as specified.

P. Piping in trenches shall hang from angle iron cross supports provided by the Contractor with two coatings of red led primer and final coat of black asphaltum paint.

Q. Hanger rods shall be attached to preset concrete inserts with steel reinforcing rod through the insert and both ends hooked over the reinforcing mesh. For pipes 4 inches and larger, rods shall extend through concrete slab above where they shall be attached to steel bearing plates 6" x 6" x 1/4".

R. Piping shall not be hung from other piping, ducts, conduits or from equipment of other trades and no vertical expansion shields will be permitted. Hanger rods shall not pierce ducts.

S. All water piping connected to rotating equipment within all mechanical spaces shall be isolated from the building structure by means of vibration hangers inserted in the hanger rods. The vibration hangers shall consist of a steel spring in combination with a double deflection neoprene element within a rectangular steel housing. Combined static deflection shall be 1.375" minimum. Hangers shall have capability of supporting the piping at a fixed elevation during installation and shall incorporate an adjusting device to transfer the load to the spring. Deflection shall be indicated by means of scale. Vibration hangers shall be type PCDNHS made by Mason Industries.

T. All steam condensate piping within all mechanical spaces shall be isolated from the building structure by means of double deflection neoprene vibration hangers inserted in the hanger rods. The vibration hangers shall consist of a double deflection neoprene element within a rectangular steel housing. Minimum static deflection shall be 1.375". Vibration hangers shall be type PCDNHS as made by Mason Industries.

U. All piping running on walls shall be supported by means of hanger suspended from heavy angle iron wall brackets. No wall hooks will be permitted.

END OF SECTION 230529

SECTION 230530 - ELECTRONIC SPEED CONTROLLERS

PART 1 – GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for each unit. Include:

1. Capacity:
   a. Horsepower
   b. Voltage
   c. Amps – both input and output
2. Wiring Diagrams:
   a. Include diagrams for basic unit and for all required accessories.
   b. Provide control wiring connections.
3. Dimensions.
4. Installation instructions.
5. Description of diagnostic system.
6. Options provided.
7. BIM objects containing IFC parameters and associated data applicable to building system requirements.
8. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
   a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance, no exceptions.
   b. Notwithstanding the calculations specified above, provide harmonic filters on all drives with an input current rating higher than 78 amps.
9. Vendor shall program one drive of each type (pump, fan, etc.) and submit a complete listing of parameters to engineer for review with commissioning authority before proceeding with programming of all drives. Provide a complete listing of all parameters for each drive as both a hard copy and electronically in both text format and the format of the manufacturer's communication/service program.
10. The VFC manufacturer shall submit a list of all parameters with a suggested setting for each drive's specific application.
11. The VFD manufacturer shall submit documentation that the drive is capable of continuous operation at a minimum of 110% of motor nameplate rating, including the service factor.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. Institute of Electrical and Electronic Engineers (IEEE) Standard 519-1992, IEEE Guide for Harmonic Content and Control.
2. Underwriters laboratories UL508C
3. National Electrical Manufacturer's Association (NEMA) ICS 7.0, AC Adjustable Speed Drives
4. IEC 16800 Parts 1 and 2

5. National Electric Code (NEC) NEC 430.120, Adjustable-Speed Drive Sys
6. International Building Code (IBC)
   a. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer:

1. Basis of Design:
   a. ABB ACH 550
2. Other Acceptable Manufacturers (provided the submitted model adheres to the spec.):
   a. Allen Bradley 700 Series
   b. Eaton SPX 9000
   c. Hitachi SJ700

B. Drive shall convert the constant frequency AC line voltage to a variable frequency, variable voltage AC output suitable for control of a standard NEMA design B induction motor over a 10:1 speed range and with full load amp rating between 65% and 130% of the drive full load current capability and without modification to the motor or the drive.

C. Variable frequency drives for all three phase motors shall have the following features:

1. Drive input: 208 or 480 volts +30% to -35%, 3 phase, 60 Hz.
2. Drive output: 0-208 or 0-460 volts, 3 phase, 0-80 Hz. For efficient operation of a variable torque load.
3. Operating conditions: Capable of continuous operation at 0 to 50^0 C (-10 to 122^0 F) ambient temperature
   a. Provide conformal coating on all printed circuit boards
4. Drive type: Pulse width modulation type, designed to minimize harmonic generated noise in the motor.
5. Enclosure type: UL type as required for location.
   a. Drives shall be UL listed as a plenum rated VFD
   b. See additional enclosure requirements herein.
6. AC line circuit breaker.
7. Input fuses for the VFD which shall ensure operation of the bypass in the event of the short circuit of the VFD
8. The input current rating of the VFD shall be no more than 3% greater than the output current rating.
9. Provide VFD one horsepower size higher than motor size for drives where input current rating of the VFD is more than 3% greater than the output current rating.
10. Coordinate additional costs with contractor, ensure no additional cost to engineer and/or owner.
11. Metal oxide varistors on incoming line for transient protection.
12. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.

13. The VFD and Bypass shall be rated 100,000 SCCR for short circuit interrupt.
    a. The installation fuses is not an acceptable design for SCCR rating.
14. 120 volt Control power transformer with fused primary and fused secondary.
    a. Control power shall be fed from the DC bus.
    b. Control contactors shall be 120V; 24 V are not acceptable.
15. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
    a. Start-up assistant
    b. Parameter assistants
        1) PID assistant
        2) Reference assistant
        3) I/O assistant
        4) Serial communications assistant
        5) Option module assistant
        6) Panel display assistant
        7) Low noise set-up assistant
    c. Maintenance assistant
    d. Troubleshooting assistant
    e. Drive optimizer assistants
    f. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
        Output Frequency
        Motor Speed (RPM, %, or Engineering units)
        Motor Current
        Motor Torque
        Motor Power (kW)
        DC Bus Voltage
        Output Voltage
16. Instantaneous overcurrent shutdown with indicator light when current exceeds 200%. Time-overcurrent overload protection for the motor.
17. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays.
18. Inverse characteristic time-overcurrent overload protection for the motor sized in accordance with NEC requirements.
19. Drive shall be capable of withstanding random application of an output short circuit without damage to drive components or fuses.
20. Input phase loss and undervoltage protection.
21. Torque/current limit control which will slow the motor without tripping when the motor is subjected to an overload, or slow the acceleration ramp when accelerating a high inertia load.
22. Drives shall be capable of “riding through” a momentary loss of power for up to 2 seconds.

23. Provide AC line reactors in the drive cabinet for each VFD with an input current rating above 78 Amps for protection against line notching and surges without requirement for an input isolation transformer. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add an AC line reactor.
24. There shall be no VFD components shipped loose and / or mounted external to the VFD cabinet
25. Power factor shall be minimum 95% at all speeds and loads.
26. UL listed
27. Minimum and maximum speed adjustment.
28. Factory Tests: The VFD shall be tested with the system logic and given complete factory tests including simulated operation.
    a. Provide certification this test has been made for the particular units shipped for this job.
29. Field Adjustments: Independent acceleration/deceleration rates: 0.5 – 120 seconds.
30. Provide a maximum of 1000 volts at the motor terminals.

D. Control Interface Components

1. Provide every VFD complete with all control devices to accomplish each function described in the specification. Field installation of sensors, relays, terminal strips, etc. is not permitted. Provide all transducers, relays and interface devices factory installed and wired to a dedicated terminal strip to provide the following functions (described elsewhere in the specification) as follows:
    a. Proof of flow – current sensing
    b. Damper control
    c. Smoke control – all modes as described herein
    d. Broken belt
    e. Single phase protection
    f. Welded contactor
    g. Amps – all phases
    h. Volts – all phases

E. Serial Communications – addressable for drive and separately for the bypass

1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. [Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available.] Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.
2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
    a. Data Sharing – Read Property – B.
    b. Data Sharing – Write Property – B.
    c. Device Management – Dynamic Device Binding (Who-Is; I-Am).

d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
e. Device Management – Communication Control – B.

3. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.
4. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
5. Serial communication in bypass shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.
6. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the DDC system. This allows for remote monitoring of which (of up to 4) safeties are open.
7. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.

F. Harmonic Filter - provide integral harmonic filters as part of the factory assembled VFD package, completely wired including interface of all monitoring and control points to the VFD serial communications. The integral harmonic filter shall be provided as follows:

1. The harmonic filter shall be designed to filter all characteristic low frequency harmonics (5th, 7th, 11th, 13th, etc.) .
2. The filter shall consist of inductive element(s) in series with the load and an inductive-capacitive network in shunt with the load. The shunt circuit shall be tuned to 4.7 times the fundamental frequency.
3. The filter shunt circuit shall be protected by field replaceable fuses on each phase to ensure the VFD remains operational in the event of a capacitor over current or other

condition causing the fuses to open. Fuses internal to the capacitor cell shall not be acceptable in lieu of field replaceable fuses.

4. The filter shall have a fuse status which is monitored by a digital input on the VFD and available to the serial communications interface.
5. The filter shall have a labeled SCCR rating of 100kA per UL 508A. An SCCR rating of EXEMPT will not be accepted as a valid alternative.
6. The Total Demand Distortion (TDD) of the current at the input terminals of the filter, in combination with the variable frequency drive, shall not exceed 5% THID at full rated load and given the filter is correctly applied.
7. The Total Harmonic Voltage Distortion (THVD) at the input terminals of the filter in combination with the variable frequency drive shall not exceed the limits defined in Table 10-2 of IEEE-519.
8. The full load efficiency of the filter shall not be less than 97% for filters larger than 5 HP or less than 98.5% for filters larger than 25 HP. The voltage regulation at the VFD terminals and attributable to the filter shall not exceed 5%. Filters with greater than 10% voltage drop, and/or filters that have capacitors in series with the VFD, are not acceptable.
9. The filter shall have a shunt capacitor in the circuit to control the capacitive VARS on the power system. The contactor shall be controlled by a digital output on the VFD. Both shunt circuit inductors and series line reactors shall be designed for harmonic filtering service and for slowing the rate of rapid current changes.
10. The inductors shall be UL component-recognized or listed and shall be built to comply to UL 508. Construction shall be of copper wire-wound on magnetic steel cores. Inductors shall be three-phase. Series line reactors shall be sized appropriately for the total connected load. Design maximum temperature rise for inductors shall be 115°C on bobbin wound and 155°C on form wound devices at rated current. Windings shall consist of copper wire or of copper foil. Terminations shall be copper alloy ring lugs, UL-recognized terminal blocks, or solid copper bus. Completed inductors shall be impregnated, using 100% solid epoxy resin. All insulation varnish systems shall be rated class H (180°C) or class R (220°C), 600V. Inductors shall be Hi-Pot tested (2,500V, 60 Hz, 1 minute) line-to-line and line-to-ground.

G. Bypass Controller - All variable frequency drives shall be equipped complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD input fuses are required. UL Listed motor overload protection shall be provided in both drive and bypass modes.

1. Drives with an INPUT Amp Rating equal to 114 Amps or greater must include a solid state soft starter in the bypass circuit. The soft starter must include a shunt contactor which will close when the motor reaches full speed.
2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the “Off” position before either enclosure may be accessed.
3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 amps and this rating shall be indicated on the UL data label.
4. The drive and bypass package shall be seismic certified and labeled to the IBC:
   a. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake table test data as defined by ICC AC-156.
5. Drive Isolation Fuses - To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability

in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted.

6. The bypass shall include a minimum of two contactor (motor and bypass) and a lockable service switch to isolate the drive while in bypass mode. Designs that use a third contactor for drive isolation must also provide a lockable disconnect in series with the drive contactor for positive means of isolation avoiding the possibility of the drive contactor being welded closed.
7. The system (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage range. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain “sealed in” over this voltage tolerance at a minimum.
8. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
9. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
    a. All current sensing transducers to accomplish single phase detection must be factory mounted. Faults for single phase must be displayed on the keypad and communicated over serial interface.
10. The bypass system shall NOT depend on the VFD for bypass operation. The bypass system shall be designed for stand alone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed.
11. Serial communications – the bypass shall be capable of being monitored and / or controlled via serial communications. On-board communications protocols shall include ModBus; Johnson Controls N2; Siemens Building Technologies FLN (P1); and BACnet.
12. Serial communication capabilities shall include, but not be limited to; bypass run-stop control; the ability to force the unit to bypass; and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus and / or via a Form-C relay output – keypad “Hand” or “Auto” selected, bypass selected, and broken belt indication. The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode over serial communications. A minimum of 50 field serial communications points shall be capable of being monitored in the bypass mode.
13. The bypass serial communications shall allow control of the bypass’ digital outputs via the serial interface. This control shall be independent of any bypass function or operating state. The bypass’ digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the bypass’ digital inputs shall be capable of being monitored by the DDC system.
14. There shall be an adjustable motor current sensing circuit for the bypass and VFD modes to provide proof of flow (broken belt) indication. The condition shall be indicated on the

keypad display, transmitted over the building automation protocol and / or via a Form-C relay output contact closure. The broken belt indication shall be programmable to be a system (drive and bypass) indication. The broken belt condition sensing algorithm shall be programmable to cause only a warning or a fault and / or system shutdown.

15. The digital inputs for the system shall accept 24VAC or 24VDC. The bypass shall incorporate an internally sourced power supply and not require an external control power source. The bypass power board shall supply 250 ma of 24 VDC for use by others to power external devices.
16. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, time-clock control, digital input, or serial communications) the bypass shall provide a dry contact closure that will signal the damper to open (motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a bypass system input and allows motor operation. Up to four separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. This feature will also operate in Fireman's override / smoke control mode.
17. The bypass control shall monitor the status of the VFD and bypass contactors and indicate when there is a welded contactor contact or open contactor coil. This failed contactor condition shall be indicated on the bypass LCD display, programmed to fire a Form-C relay output, and / or over the serial communications protocol.
18. The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.
19. There shall be a keypad adjustment to select manual or automatic transfer bypass. The user shall be able to select via keypad programming which drive faults will result in an automatic transfer to the bypass mode and which faults require a manual transfer to bypass. The user may select whether the system shall automatically transfer from drive to bypass mode on the following drive fault conditions:
    a. Over current
    b. Over voltage
    c. Under voltage
    d. Loss of analog input
    e. The following operators shall be provided:
        1) Bypass Hand-Off-Auto
        2) Drive mode selector
        3) Bypass mode selector
        4) Bypass fault reset
20. The bypass shall include a two line, 20 character LCD display. The display shall allow the user to access and view:
    a. Energy savings – in US dollars
    b. Bypass motor amps
    c. Bypass input voltage– average and individual phase voltage
    d. Bypass power (kW)
    e. Bypass faults and fault logs
    f. Bypass warnings
    g. Bypass operating time (resettable)
    h. Bypass energy (kilowatt hours – resettable)
    i. I/O status

j. Parameter settings / programming
k. Printed circuit board temperature

21. The following indicating lights (LED type) or keypad display indications shall be provided. A test mode or push to test feature shall be provided.
    a. Power-on (Ready)
    b. Run enable
    c. Drive mode selected
    d. Bypass mode selected
    e. Drive running
    f. Bypass running
    g. Drive fault
    h. Bypass fault
    i. Bypass H-O-A mode
    j. Automatic transfer to bypass selected
    k. Safety open
    l. Damper opening
    m. Damper end-switch made
22. The Bypass controller shall have six programmable digital inputs, and five programmable Form-C relay outputs. This I/O allows for a total System (VFD and Bypass) I/O count of 24 points as standard. The bypass I/O shall be available to the BAS / DDC system even with the VFD removed.
23. The on-board Form-C relay outputs in the bypass shall programmable for any of the following indications.
    a. System started
    b. System running
    c. Bypass override enabled
    d. Drive fault
    e. Bypass fault
    f. Bypass H-O-A position
    g. Motor proof-of-flow (broken belt)
    h. Overload
    i. Bypass selected
    j. Bypass run
    k. System started (damper opening)
    l. Bypass alarm
    m. Over temperature
24. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.
25. The bypass shall include a supervisory control mode. In this bypass mode, the bypass shall monitor the value of the VFD's analog input (feedback). This feedback value is used to control the bypass contactor on and off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps even with the VFD out of service.
26. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat", "FreezStat", "Over pressure" and "Low suction". The user shall also be able to determine which of the four (4) safety contacts is open over the serial communications connection.

27. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer the motor from VFD mode to Bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. The Smoke Control Override Mode action is not programmable and will always function as described in the bypass User's Manual documentation. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties as required by UL 864/UUKL. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.
28. Stair Pressurization Mode – the bypass shall include an option to control the speed of the motor based on an external pressure transmitter. In this mode the VFD shall modulate the speed of the motor to maintain a pressure setpoint and avoid over pressurization of the stairwell.
29. Preset speed mode – the bypass shall include an option to run the drive at a preset speed and follow the acceleration values programmed in the VFD. The preset speed can be any fixed value.
30. Fireman's Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge some digital inputs, all digital inputs, ignore digital inputs or any combination of the above. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction". The user may also force the unit into Override 2 via the serial communications link.
31. Class 10, 20, or 30 (programmable) electronic motor overload protection shall be included.

H. In addition to the above feature all drives shall have the following additional features:

1. Catch-a-spinning load capability.
2. Critical speed avoidance capability.
3. Where the building walls are not suitable for mounting drives a floor stand kit shall be provided.
4. Provide output isolator to provide VFD signal operation of frequency, and current to an isolated 4-20 mA signal for transmission to the building automation system for monitoring capability.

I. For variable frequency drives serving multiple motors, the following shall be provided:

1. Provide redundant drives, each drive sized for the aggregated load of all motors.
2. The system shall monitor drive performance and switch to the standby drive in the event of a drive failure.
3. The system shall balance run time between drives
4. Manual switchover will be required in an instance of electrical system deficiencies such as under voltage, ground fault, single phase input, etc.
5. Provide motor contactors for each motor for drives serving more than one motor, each contactor shall have auxiliary contacts to prevent drive damage if remote motor disconnect switch is open of closed.
6. Each drive shall have contactors for each motor it serves with individual thermal overload protection for each motor and H-O-A motor select switch.
7. All multiple motor variable speed controllers shall be capable of operating even if one of the motors is off.

8. Multiple motor protectors must be integral to the VFD enclosure.

J. Enclosure: NEMA Type as required for location.

1. Provide NEMA 4X stainless steel enclosures in wash down areas, kitchens, dishwasher areas, exterior spaces, and any other areas designated by the Engineer. Provide space heater/air conditioning as well as all necessary conditioning within the enclosure as required to maintain the minimum internal temperature required by the manufacturer. Air conditioning shall be powered by a single point of connection within the cabinet.
2. Provide NEMA 3r enclosures for drives exposed to weather. NEMA 3 r enclosures shall be fabricated from 304 SS with protected keypads. The enclosure shall be bottom entry and shall include heating and ventilation to maintain and operation environment during design conditions

K. For drive manufacturers who use portable test meter for diagnostics, provide not less than one test meter for each model or type used. Meters shall be supplied to the Owner upon completion of the project.

L. Provide one complete set of spare fuses for all variable speed controllers.

M. Interlock all disconnects with variable speed drive so variable speed drive opens before disconnect opens to prevent damage to the drive.

PART 3 – EXECUTION

3.1 Deliver units to installer of electrical work. Provide installation and wiring instruction and diagrams.

3.2 Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer. The local service office shall be staffed by factory trained engineers within a 100-mile radius of the job site. Training shall be provided for the Owner’s service personnel at the Owner’s facility.

3.3 Provide wiring control diagrams and instructions to installer of automatic temperature controls.

3.4 Provide Two years warranty to cover parts and labor.

3.5 In applications where the drive will be more than 100 feet of cable from the motor, it is the responsibility of the contractor to have the manufacturer coordinated with the motor manufacturer to ensure that the motor is suitable for the application, or to provide a motor protecting DV/DT filter on the drive output to protect the motor. The manufacturer shall adjust the carrier frequency to minimize the audible noise of the connected motor.

3.6 An as-built drive control schematic (ladder diagram) shall be taped to the inside of the drive cabinet and sent to the Project Engineer and be included as part of the closeout document package.

END OF SECTION 230530

SECTION 230548 - VIBRATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract, and Specification Sections (General Requirements), apply to this Section.

1.2 DESCRIPTION

A. Furnish and install all vibration control devices, accessories, materials, and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.

1.3 MATERIAL AND EQUIPMENT

A. Design Basis: Mason Industries

B. Alternate Manufacturers:

1. Vibration Eliminator Co.
2. Korfund Dynamics Corp.
3. Amber/Booth Co.
4. Vibration Mountings & Controls, Inc.

C. Unless otherwise specified, supply only new equipment, parts and materials.

1.4 QUALITY ASSURANCE

A. Firms regularly engaged in manufacture of this equipment with characteristics and capacities required, whose products have been in satisfactory use in similar service for not less than ten (10) years.

B. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

C. Provide vibration isolators of the appropriate sizes, with the proper loading to meet the specified deflection requirements.

D. Supply and install any incidental materials needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim or additional payment.

E. Verify correctness of equipment model numbers and conformance of each component with manufacturer’s specifications.

F. Should any rotating equipment cause excessive noise or vibration, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer’s specifications for the

unit in question.

1.5 SUBMITTALS

A. Prior to ordering any products, submit shop drawings and the items listed below. The shop drawings must be complete when submitted and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection of the submittal. Contractor shall provide:

1. A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:
   a. The equipment identification mark;
   b. A cut sheet of the isolated equipment showing equipment support points and operating weight at each point.
   c. The isolator type;
   d. The actual load;
   e. The static deflection expected under the actual load;
   f. Specified minimum static deflection;
   g. The additional deflection-to-solid under load;
   h. The ratio of spring height under load to spring diameter.
3. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.
4. Special details necessary to convey complete understanding of the work to be performed.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION MOUNT TYPES

A. General:

1. All mechanical equipment shall be mounted in accordance with the specifications below and for the specific requirements shown in the equipment schedule.
2. The isolation manufacturer shall supply all unit isolators, complete rails, fan and motor bases and structural steel forms for concrete inertia blocks, where called for and shall be responsible for the selection of all vibration eliminators and shall guarantee to meet the requirements of these Specifications.
3. Wherever rotational speed is mentioned as the disturbing frequency, the lowest speed in the system shall be used. All isolation devices shall be selected for uniform static deflections according to distribution of weight. Lateral motion of all isolators shall be 1/4" maximum during start-up and shut-down.
4. All metal parts of vibration isolation units installed out-of-doors shall be cold-dip galvanized, cadmium plated, or neoprene coated after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14. Isolators shall be equipped with limit stops to resist wind velocity.
5. All isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.
6. Isolator types are scheduled to establish minimum standards. At the Contractor’s option, laborsaving accessories can be an integral part of isolators supplied to provide initial lift

of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories must not degrade the vibration isolation system.

7. Static deflection of isolators shall be as provided in SECTION 3 - EXECUTION. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.
8. All fan units and air handling units (except fans with wheels under 27") shall be isolated as follows:

    1. Up to 450 RPM: 75% efficiency (3-1/2" maximum deflection)
    2. 450 RPM to 850 RPM: 90%
    3. 850 RPM and over: 95%

    Submittals shall show disturbing frequency, required efficiency, designed deflection and outside diameter of springs, when pertinent.

9. Weight of concrete inertia blocks shall be as follows:

    1. Fans and air handling units (up to 5" s.p.) driven by 75 HP and larger motors: 1-1/2 times weight of equipment.

10. All horizontal pipe connected to rotating equipment within the mechanical equipment room area, but not less than 50 feet from connected equipment shall be isolated from building structure by means of units designed for insertion in rods.

B. Type FSN (Floor Spring and Neoprene)

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one (1). All mounts shall have leveling bolts.
2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer’s recommended range.
3. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
4. If the isolator is to be fastened to the building structure and Type NP isolator is used under the bearing plate, neoprene grommets shall be provided for each bolt hole in the base plate. Bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers are to be galvanized.

    Type FSN isolators shall be Mason Type SLF with the appropriate neoprene pad (if used) selected from Type NP or approved equal.

C. Type FSNTL (Floor Spring and Neoprene Travel Limited)

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall not be less than 0.8 of the compressed height of the spring at the rate load. Spring shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one (1). All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of ¼" shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.
2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
3. If the isolator is to be fastened to the building structure and Type NP isolator is used under the bearing plate, neoprene grommets shall be provided for each bolt hole in the base plate. Bolt holes shall be properly sized to allow for grommets. Hold down assembly shall include washers to distribute load evenly over the grommets. Bolts and washers are to be galvanized.

   Type FSNTL isolators shall be Mason Type SLR with the appropriate neoprene pad (if used) selected from Type NP or approved equal.

D. Type FN (Floor Neoprene)

1. Neoprene isolators shall be neoprene-in-shear type with steel reinforced top and base. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.

   Type FN isolators shall be Mason Type ND or approved equal.

E. Type NP (Neoprene Pad)

1. Neoprene pad isolators shall be one layer of ¼" to 3/8" thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

   Type NP isolators shall be Mason Type W or approved equal.

F. Type DNP (Double Neoprene Pad)

1. Neoprene pad isolators shall be formed by two layers of ¼" to 3/8" thick ribbed or waffled neoprene, separated by a galvanized steel, stainless steel or aluminum plate. If the

isolator is outdoors, the plate shall not be made of galvanized steel. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

Type DNP isolators shall be Mason Type WSW or approved equal.

G. Type HSN (Hanger Spring and Neoprene)

1. Vibration isolation hangers shall consist of a free standing and laterally stable steel spring and a neoprene element in series, contained within a steel housing. Spring diameters and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the housing. Hangers shall provide a means to adjust hanger elevation under load. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring elements shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. The neoprene element shall be designed to have a 0.3" minimum static deflection. The deflection of both the spring element and the neoprene element shall be included in determining the overall deflection of Type HSN isolators.

Type HSN isolators shall be Mason Type P30N or approved equal.

H. Type DSN (Double deflection spring and neoprene)

1. Vibration hangers shall contain a steel spring and a double deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection and be seated in a neoprene cup with an integral molded bushing that passes through the lower hanger box.

Type DSN isolators shall be Mason type DNHS or approved equal.

I. Type HN (Hanger Neoprene)

1. Vibration isolation hangers shall consist of a neoprene-in-shear element contained within a steel housing. A neoprene neck bushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30º arc before contacting the hanger housing.

Type HN isolators shall be Mason Type HD or approved equal.

2.2 FLEXIBLE DUCT CONNECTORS

A. Flexible duct connection shall be made from coated fabric (or leaded vinyl if called for on the drawings). The clear space between connected parts shall be a minimum of 3" and the connection shall have 5" minimum of slack material.

2.3 FLEXIBLE PIPE CONNECTIONS

A. Flexible pipe connection shall be fabricated of multiple plies of nylon cord, fabric, and neoprene; and shall be vulcanized so as to become inseparable and homogeneous. Flexible connections

shall be formed in a double sphere shape, and shall be able to accept compressive, elongative, transverse, and angular movements.

B. The flexible connections shall be selected and specially fitted, if necessary, to suite the system temperature, pressure, and fluid type. In addition, suitable flexible connections should be selected which do not require rods or cables to control extension of the connector.

C. Connectors for pipe sizes 2" or smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings.

D. Provide Mason Industries Type MFTNC or MFTFU; Metraflex Twin Sphere; or Amber/Booth Type 2600 or 2655 for flexible pipe connections less than 220˚F and 150 psi.

E. Flexible pipe connections shall be mason Industries Type BSS braided stainless steel hose with carbon steel fittings for pressures above 150 psi or temperatures greater than 220˚F

2.4 RESTRAINTS

A. Snubber:

1. Snubbers shall be custom fabricated using Type FN isolators mounted to steel angle brackets. The steel angle shall be sufficiently rigid and the mounting sufficiently secure to resist excessive movement of equipment during on-off cycle.

B. Thrust Restraints:

1. Thrust restraints shall consist of a spring element in series with a neoprene pad. The unit shall be designed to have the same deflection due to thrust-generated loads as specified for the isolators supporting the equipment. The spring element shall be contained within a steel frame and be designed so it can be precompressed at the factory to allow for a maximum of ¼" movement during starting or stopping of the equipment. Allowable movement shall be field-adjustable.
2. The assembly shall be furnished complete with rods and angle brackets for attachment to both the equipment and the adjacent fixed structural anchor.
3. Thrust restraints shall be Mason Industries Type WB, Kinetics Noise Control Type HSR, Amber/Booth Type TRK or an equal product of the manufacturer supplying the isolators.

2.5 GROMMETS

A. Grommets shall either be custom made by combining a neoprene washer and sleeve, be Isogrommets as manufactured by MBIS, Inc. (Bedford Heights, Ohio), or be Series W by Barry Controls (Watertown, Mass.). Grommets shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall be specially formed to prevent both from directly contacting the isolator base plate.

2.6 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes as described in this specification shall be silicone or one of the non-setting sealants indicated below:

Acoustical Sealant D.A.P

BR-96	Pecora
Acoustical Sealant	Tremco
Acoustical Sealant	U.S.G.

PART 3 - EXECUTION

3.1 APPLICATION

A. General:

1. Refer to SECTION 2 - PRODUCTS of this specification for vibration isolation devices identified on the drawings or specified herein.
2. The static deflection of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflection are not acceptable and will be disapproved.
3. Refer to Section 23 05 49 for seismic requirements.

B. Major Equipment:

1. Unless otherwise shown or specified, all floor-mounted major equipment shall be set on 4” high concrete housekeeping pads. Mount vibration isolating devices and related inertia blocks on concrete pads.
2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as scheduled on the drawings or specified hereunder.
3. Flexible duct connections shall be installed at all fan unit intakes, fan unit discharges, and wherever else shown on the drawings.
4. Flexible pipe connections shall be installed at all pipe connections to vibration-isolated equipment, refer to drawings for proper position.
5. Thrust restraints shall be installed on all floor-mounted fans developing 4” or more of static pressure, all suspended fans developing 2” or more static pressure, and wherever else called for on the drawings.
6. Snubbers shall be installed as called for on the drawings.
7. Brackets shall be provided to accommodate the isolator. The vertical position and size of the bracket shall be specified by the isolator manufacturer.

C. Miscellaneous Mechanical Equipment:

1. Miscellaneous pieces of mechanical equipment such as converters, pressure reducing stations, dryers, strainers, storage tanks, condensate receiver tanks, and expansion tanks which are connected to isolated piping system shall be vibration isolated from the building structure by Type NP or Type HN isolators (selected for 0.1” static deflection) unless their position in the piping system requires a higher degree of isolation as called for under Pipe Isolation.

D. Pipes:

1. All chilled water, condenser water, heating water, drain and engine exhaust piping that is connected to vibration-isolated equipment shall be isolated from the building structure within the following limits:
   a. Within mechanical rooms.

b. And within 50’ total pipe length of connected vibration-isolation equipment (chillers, pumps, air handling units, pressure reducing stations, etc.):

2. Piping shall be isolated from the building structure by means of vibration isolation mounts, resilient pipe guides, and resilient penetration sleeve/seals.
3. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than ½” Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to ½”, Type FN or HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or HN achieving at least ¼” static deflection.
4. Where lateral support of pipe risers is required within the specified limits, this shall be accomplished by use of resilient lateral supports.
5. Pipes within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
6. Provide flexible pipe connections on all piping connected to all isolated equipment, when required by manufacturer, and wherever shown on the drawings.

3.2 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General:

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with the manufacturer’s instructions.

B. Isolation Mounts:

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
2. Isolators for equipment with bases shall be located on the sides of the bases, which are parallel to equipment shaft unless this is not possible because of physical constraints.
3. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called to herein.
4. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.
5. Hanger rods for vibration-isolated support shall be connected to structural beams or joists, not the floor slab between beam joists. Provide suitable intermediate support members as necessary.
6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360º about the rod axis without contacting any object.
7. Parallel running pipes may be hung together on a trapeze, which is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and non-isolated pipes on the same trapeze.
8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.

9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
10. The installed and operating heights of equipment vibration-isolated with Type FSNTL isolators shall be identical. Limit stops shall be out of contact during normal operation. Adjust isolators to provide ¼" clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.
11. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Flexible Duct Connections:

1. Sheet metal ducts and plenum opening shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section prior to installation of the flexible connection, so the clear length is approximately equal all the way around the perimeter. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

D. Flexible Pipe Connections:

1. Install flexible pipe connections in strict accordance with the manufacturer's instructions.

E. Restraints:

1. Snubbers shall be adjusted to clear the equipment base and to provide lateral restraint during on-off cycling, but be out of contact during normal operation of the equipment.
2. Thrust restraints shall be attached at the centerline of thrust and symmetrically on each side of the unit. The two rods of the thrust restraint shall be axially aligned. This may require modified brackets or standoffs. The body of the thrust restraint shall not come in contact with the connected elements. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.

F. Resilient Penetration Sleeve/Seals:

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.
   a. At minimum, provide resilient penetration seals at all Mechanical, Equipment and Fan Room Penetrations.

3.3 ISOLATOR SCHEDULE

UNIT	ISOLATOR TYPE	MINIMUM STATIC DEFL.(IN.)	BASE TYPE	REMARKS
Rooftop Air Handling Units	BC-1	1.5	BC-1	
Inline Fans (Suspended)	HSN	2		
Fan Coil Units & Evaporators	(Note 2)	(Note 2)		

Self-Contained Air Conditioning Units	FSN (Note 1)	1.5		Thrust restraints if internally isolated.
Utility Fans (Suspended)	HSN	2.0		
In-line Fans (Floor Mounted)	FSNTL	2.0		
Split system condensing unit	NP			[Confirm if size requires additional isolators]

Notes:

(1) External isolator may be omitted if units have internally isolated fans and no other rotating or reciprocating components.
(2) Isolators for fan coil units should be either HSN with 0.75” minimum static deflection or be equivalent to Mason Industries Type HN with 0.35” minimum static deflection.
(3) For slab-on-grade installations isolators are not required. Refer to section 23 21 23.

3.4 INSPECTION AND COORDINATION

A. Contractor shall examine location where this equipment is to be installed and determine space conditions and notify Architect in writing of conditions detrimental to proper and timely completion of the Work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

C. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.

D. Bring to the Architect's attention, prior to installation, any conflicts with other trades which may result in unavoidable rigid contact with equipment or piping as described herein, duct to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation shall be at the responsible Contractor's expense.

E. Bring to the Architect's attention, any discrepancies between the Specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the Contractor's expense.

3.5 FIELD QUALITY CONTROL

A. Obtain inspection and approval of any installation to be covered or enclosed, prior to such closure.

B. Upon completion of installation of all vibration isolation devices herein specified, the local representative of the isolation materials manufacturer shall inspect the completed system and report, in writing, any installation error, improperly selected isolation devices, or other faults in the system that could affect the performance of the system. Contractor shall submit a report to the Architect, including the manufacturer's representatives final report, indicating all isolation reported as improperly installed or requiring correction, and include a report by the Contractor

on steps taken to properly complete the isolation work.

END OF SECTION 230548

SECTION 230549 - SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Locate, select, design, and install seismic restraints for all mechanical systems. Include restraints for ductwork, piping and equipment.

1.2 CODES, STANDARDS

A. Comply with the requirements of the “Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems”, first edition.

B. Design seismic restraint systems for seismic Zone 2 with an effective peak velocity - related acceleration coefficient (A_v) of 0.10 to 0.19.

DESIGN LEVEL OF ACCELERATION AT EQUIPMENT CENTER OF GRAVITY			
SEISMIC ZONE 2, A_V = 0.10 TO 0.19			
ELEVATION ABOVE GRADE	RIGIDLY FLOOR OR WALL MOUNTED EQUIPMENT	RESILIENTLY MOUNTED AND/OR SUPPORTED FROM CEILING OR STRUCTURE ABOVE	LIFE SAFETY EQUIPMENT (FIRE ALARM, EMERGENCY)
BELOW GRADE UP TO 20 FEET ABOVE GRADE	0.100 “G” 0.125 “G”	0.500 “G”	1.000 “G”
21 FEET to 300 FEET	0.500 “G”	0.750 “G”	

1.3 SUBMITTALS

A. Submit manufacturer’s data for all manufactured restraints.

B. Submit shop drawings for all fabricated restraints.

C. Show restraint type and location on the sheet metal and piping shop drawings.

D. Provide an affidavit signed by a registered New York State licensed structural engineer certifying that all mechanical systems requiring such have been properly engineered and designed for seismic Zone 2.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Design Basis: Mason

1. Other Acceptable Manufacturers:

a. M.W. Sausse and Company, Inc.
b. Vibration Mounting and Controls, Inc.
c. California Dynamics Corporation
d. By prior approval

PART 3 - EXECUTION

3.1 GENERAL NOTES FOR BRACING OF DUCTS

A. Details shown in the Guidelines provide a lateral bracing system. A typical vertical support system conforming to the standards must also be used. However, where bracing occurs, the required vertical angle may replace a typical vertical support. This includes a trapeze vertical supporting system.

B. Brace all rectangular ducts 6 sq. ft. of area and larger. Brace all round ducts 38” in diameter and larger.

C. Transverse bracing to occur 30’ - 9” o.c. maximum. (Except rectangular ducts 61” and larger in either direction may be braced at 32’ - 0” o.c.) Transverse bracing shall be installed at each duct turn and at each end of a duct run.

D. Longitudinal bracing shall occur at 60’ - 9” o.c. maximum. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it, if the bracing is installed within four feet of the intersection of both ducts and bracing is sized for the larger duct. Duct joints shall conform to SMACNA duct construction standard. All joints in duct sections shall provide a positive fastening together of the section.

E. No bracing is required if the top of duct is suspended 12” or less from the supporting structural member.

F. A group of ducts may be combined in a larger size frame using the overall dimensions.

G. Walls (including gyp-board non-bearing partitions) which have ducts running throughout them may replace a typical transverse brace. Provide solid blockings around duct penetration at stud wall construction.

H. Ducts and pipes not braced shall be installed with a 6” minimum clearance to vertical ceiling hanger wires.

I. All sheet metal for bracing to be F(y) = 33 ksi.

J. Minimum U.S. Standards gauge for sheet metal for bracing to be as follows:

16 gauge (0.0598 inch)
14 gauge (0.0747 inch)
12 gauge (0.1046 inch)

K. It is the responsibility of the Contractor to ascertain that an appropriate size device be selected for each individual piece of equipment. Submit signed and sealed drawings from a New York

State licensed professional engineer confirming seismic design.

3.2 GENERAL NOTES FOR BRACING OF PIPES

A. These Guidelines are not intended for the seismic design of the piping. Piping shall be designed with consideration given to the dynamic properties of the piping and the structure.

B. Bracing details, support details, schedules and notes listed in the Guidelines apply to all types of pipe and all type of joints.

1. Bracing
   a. Brace all pipes 2½" diameter and larger.
   b. Brace all piping 1¼" and larger located in boiler rooms, mechanical equipment rooms and refrigeration machinery rooms. Bracing requirements for pipes less than 2½" in diameter shall be the same as for 2½" pipes in all other locations.
   c. Seismic braces may be omitted:
      1) When the top of the pipe is suspended 12" or less from the supporting structure member and the pipe is suspended by an individual hanger.
      2) On all piping ¾" and smaller.
2. Details shown in the Guidelines provide a lateral bracing system. A typical vertical support system conforming to the above standard must also be used.
   a. Vertical Piping
      1) Attachment - Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Stacks shall be supported at their bases and if over 2 stories in height at each floor by approved metal floor clamps.
      2) Screwed pipe (I.P.S.) shall be supported at not less than every other story height.
      3) Copper tubing - copper tubing shall be supported at each story for piping 1½" and smaller in diameter.
      4) Pipes of other approved material shall be supported in accordance with their approved installation standards.
   b. Horizontal Piping
      1) Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
      2) Screwed pipe - Screwed pipe (I.P.S.) or flanged pipe shall be supported at approximately 10 foot intervals.
      3) Copper tubing - Copper tubing shall be supported at approximately 6 foot intervals for tubing 1½" and smaller in diameter and 10 foot intervals for tubing 2" and larger in diameter.
      4) Pipes of other approved materials shall be supported in accordance with their approved installation standards.
3. Provide transverse bracings at 40' - 0" o.c. maximum unless otherwise noted in the Guidelines.
4. Provide longitudinal bracings at 80' - 0" o.c. maximum unless otherwise noted in the Guidelines. When thermal expansion or contraction is involved, provide longitudinal bracings at anchor points. The longitudinal braces and the connections must be capable of resisting the force induced by expansion and contraction.
5. Transverse bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24" of the elbow or tee of similar size.

6. For threaded piping the flexibility may be provided by the installation of swing joints. In welded or solder joint piping the flexibility shall be provided by expansion loops or manufactured flexible connectors. For piping with manufactured ball joints select length of piping offset using “Seismic Drift” in place of “Expansion Per Joint Manufacturers” selection table. Seismic Drift = 0.015 ft. per foot of height.
7. Do not use branch lines to brace main lines.
8. Trapeze hangers may be used. Provide flexibility in joints where pipes pass through building seismic or expansion joints, or where pipes pass through building seismic or expansion joints, or where rigidly supported pipes connect to equipment with vibration isolators.
9. A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and a roof; solid concrete wall and a metal deck with Lightweight concrete fill.
10. Provide large enough pipe sleeves through walls or floors to allow for anticipated differential movements.
11. At vertical pipe risers, wherever possible, support the weight of the riser at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 30’ - 0” on center.
12. Cast iron pipe of all types, glass pipe and any other pipe joined with a shield and clamp assembly where the top of the pipe is 12” or more from supporting structure shall be braced on each side of a change in direction of 90^0 or more. Riser joints shall be braced or stabilized between floors.

C. Essential facilities or life safety equipment. “Essential facilities” mentioned in the Guidelines are those structures or buildings which must be safe and useable for emergency purposes after an earthquake in order to preserve the health and safety of the general public.

3.3 GENERAL NOTES FOR EQUIPMENT RESTRAINTS

A. Mechanical Equipment Anchorages such as bolts, expansion anchors, screws, etc., shall comply with the force level requirements of the above standards as well as the New York City Building Code.

B. Restraining Devices shall be designed to conform with the force level requirements of A above.

C. Restraining Devices must be placed on all sides of the equipment base.

D. It is the entire responsibility of the Equipment Manufacturer to design his equipment so that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

E. It is the responsibility of the Mechanical Contractor to ascertain and assure that an appropriate size device be selected for each piece of equipment (including whole unit restraints for internally braced equipment).

END OF SECTION 230549

SECTION 230553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Plastic Pipe Markers and method of application.
2. Engraved Plastic Laminate Sign.
3. Equipment label and valve tag schedules shall be submitted to review as an MS Excel digital file.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products.

B. Where more than a single type is specified for an application, selection is Installer's option, but provide a single selection for each application.

2.2 PLASTIC PIPE MARKERS (TYPE A)

A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.

B. For Pipes Less Than Six Inches (including insulation if any): Provide full-band pipe markers, extending 360º around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾" wide; full circle at both ends of pipe marker, tape lapped 1-½".

C. For Pipes Six Inches and Larger (including insulation if any): Provide either full-band or strip-type markers, but not narrower than 3 x letter height, taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-½" wide; full circle at both ends of pipe marker, tape lapped 3".

D. Lettering: Manufacturer's pre-printed wording which conforms to contract document system descriptions.

E. Where work is an extension or alteration of an existing system, new markers shall match existing terminology for systems which are modified or added by this work.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic (to accommodate both directions).

G. Pipe Size: All insulated pipes shall be labeled to indicate pipe size.

2.3 STENCILING (TYPE B)

A. Using a color contrasting to the surface to identify, spray or brush paint through neatly cut stencils.

B. Lettering shall conform to wording on contract documents. Size shall be in accordance with ANSI A13.1.

2.4 BACKGROUND COLOR AND STENCILING (TYPE C)

A. In addition to the requirements above, paint a background color band in accordance with ANSI A13.1.

2.5 VALVES TAGS

A. Brass Valve Tags: Provide manufacturer's standard 19 ga brass tag; approximately 1-½" round wit ½" high black filled numbers and 3/16" top hole.

1. Numbers shall be sequential in accordance with schedule below.
2. Provide separate numbering for each legend sequence. Provide separate sequences for the following:

a. Heating Water (HTG)
b. Low Pressure Steam (LPS)
c. Low Pressure Steam Condensate Return (LPCR)
d. All other systems (No legend)

B. Valve Tag Fasteners: Manufacturer's standard chain (wire link or beaded type), or S-hooks.

2.6 VALVE SCHEDULE

A. Provide schedule for each piping system, as defined on the drawings, and below, typewritten and reproduced on 8-½" x 11" bond paper.

B. Tabulate valve number, piping system, system legend (as shown on tag), location of valve (room or space), and variations for identification (if any).

C. Provide piping schematic for each system as defined below in Part 3.

D. In addition to mounted copies, furnish extra copies for maintenance manuals as specified.

E. Valve Schedule Frames: For each page of the valve schedule, provide a glazed frame, with screws for removable mounting on masonry walls.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, 1/16" thick, black with white core (letter color).

B. Fastening:

1. Screws
2. Rivets
3. Permanent Adhesive

C. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled in the construction documents.
2. In addition, for heating or cooling units and exhaust fans, identify area served.

PART 3 - EXECUTION

3.1 GENERAL

A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, install identification after completion of covering and painting.

B. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white, whichever provides most contrast with ductwork color.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50’ spacing along exposed runs.

C. Access Doors: Provide stenciled or plastic laminate type signs on each duct or equipment mounted access door in ductwork and housings, indicating the purpose of the access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers on piping of the following systems and include arrows to show normal direction of flow.

1. Heating water piping (supply and return).
2. Chilled water piping (supply and return).
3. Low Pressure Steam System (supply and return).
4. Refrigerant piping (suction, liquid, hot gas bypass).
5. Any other piping system as indicated on the drawings, or as required to match existing.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces above accessible ceilings, in accessible maintenance spaces, including chases, and above ceiling:

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where there could be a question of flow pattern.
3. Near locations where pipes pass through walls, floors, or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 25’ along each piping run.
6. Within 6’ of access doors above otherwise non-accessible ceilings and chases.

C. Type:

1. Normally exposed to view - Type A or C.
2. Normally concealed from view - Type B.

3.4 VALVE IDENTIFICATION

A. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, hose bibs, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

B. Mount framed valve schedules with piping schematics in each MER.

C. Identify each valve tagged on as-built drawings.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. Install an engraved plastic laminate sign on or near each major item of mechanical equipment.

1. Provide signs for the following general categories of equipment and operational devices:

a. Fans
b. VRF System (evaporators and condensers)
c. Packaged Air conditioning Units (including Rooftop Units)
d. Motor Starters and Variable Frequency Drives (Mount near starter)

B. Provide engraved plastic laminate nameplate on every new piece of equipment not already provided with one in accordance with Section 23 05 02 of the specifications.

C. Identify area served, if applicable.

3.6 NON-POTABLE WATER IDENTIFICATION

A. Provide an engraved plastic laminate sign.

1. Legend: “Non-Potable Water”.

2. Location: At each outlet of piping downstream of backflow preventer, (e.g. Boiler Room hose bibb).

END OF SECTION 230553

SECTION 230593 - TEST-ADJUST-BALANCE

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. Work of this section shall be completed by a sub-contractor of the HVAC contractor.

B. The Balancing Contractor shall not be a sub-contractor of any other Division 21, 22 or 23 Contractor.

1.2 QUALITY ASSURANCE

A. Qualification:

1. Work shall be done by a firm certified by the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC), or the firm shall have technicians certified by the “National Training Fund Sheet Metal & Air Conditioning Industry”.
2. The firm shall be an independent testing and balancing firm specializing in testing and balancing of environmental systems.
3. The firm shall have an experience record of not less than five (5) years experience in the TAB industry.

B. Industry Standards: Comply with the following:

1. HVAC Systems-Testing, Adjusting, Balancing published by Sheetmetal and Air Conditioning Contractors National Association, Inc. (SMACNA).
2. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems published by National Environmental Balancing Bureau. (NEBB).
3. ASHRAE Systems Handbook. Testing, Adjusting and Balancing.

C. Registration: Work shall be done under the supervision of a professional engineer registered in the jurisdiction of the work. Engineer shall be available for all meetings and interpretation of all materials in the report.

D. Pre-qualification of TAB Contractor.

1. The firm must have experience and qualifications satisfactory to the consulting mechanical engineer and must be accepted by him prior to bidding.
2. Firms desiring approval to provide work under this section shall submit a booklet indicating procedures and data forms that they would use in the performance of the work.
3. Submittals shall be in accordance with Section 23 05 02.
4. Only firms which have been approved by the mechanical engineer may provide work under this section.

PART 2 – PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL

A. Sequence work to commence after completion of system and start-up procedures and schedule completion of work before Substantial Completion of Project.

B. The project will be completed in phases and it will be necessary to balance new and existing equipment at the end of each phase.

1. Assume that any equipment installed in a phase must be balanced in its installation phase.
2. Assume that any equipment serving more than a single space will need to be rebalanced at the turnover of each phase after installation.
3. Assume that all equipment will require final balancing after the completion of the final phase.
4. Submit preliminary balancing reports at the end of each phase. Submit final balancing report at the completion of final phase.

C. Examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.

D. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work.

1. Do not proceed with the work until unsatisfactory conditions have been corrected.
2. Provide Engineer/Architect with a copy of the notification.

E. Adjust flows to within 10% of values shown. If design flows cannot be obtained within specified limits the Balancing Contractor will perform the following (at the minimum):

1. Measure and record major pressure drops in the system.
2. Consult with the Engineer and Installer as required.
3. Upon receiving written directions to proceed and after any corrections are performed, re-balance affected portion of system.

F. Optimization: Work closely with the controls contractor to optimize setpoints.

1. Establish the minimum air static pressure or water differential pressure for variable or bypass flow system.
2. Establish the position of minimum outside air dampers, damper/valve and sequencing relays.

G. Calibration: Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air systems flow measurement stations including VAV terminals shall be calibrated against a pitot tube traverse or air diffuser capture hood. Balancing contractor shall assure accuracy of all flow measurement devices or shall report on their failure

to be accurate.

H. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommended by the original Installer.

I. Make all final readings for each system at the same time, and after all adjustments have been made.

J. Mark equipment settings, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.

1. Mark with paint or other suitable permanent identification material.

K. Check all new thermal overloads.

1. Identify improperly protected equipment in report.

L. All piping and equipment shall be tested; labor including standby electrician, materials, instruments and power required for testing shall be furnished unless otherwise indicated under the particular section of the Specification.

M. Tests shall be performed in the presence and to the satisfaction of the Architect and such other parties as may have legal jurisdiction.

N. In no case shall piping, equipment, or accessories be subjected to pressure exceeding their ratings.

O. All defective work shall be promptly repaired or replaced and the tests shall be repeated until the particular system and component parts thereof receive the approval of the Architects.

P. Any damage resulting from tests to any and all trades shall be repaired and damaged materials replaced, all to the satisfaction of the Architect.

Q. The duration of tests shall be as determined by all authorities having jurisdiction, but in no case less than the time prescribed below.

R. Equipment and systems which normally operate during certain seasons of the year shall be tested during the appropriate season. Tests shall be performed on individual equipment, systems, and their controls. Whenever the equipment or system under test is interrelated and depends upon the operation of other equipment, systems and controls for proper operation, functioning and performance, and latter shall be operated simultaneously with the equipment or system being tested.

S. All fans and duct systems shall be completely balanced by the adjustment of sheaves, dampers, registers and other volume and diverting control devices, to obtain the air quantities indicated on the design drawings. Replace sheaves if required to meet design conditions.

T. All pumps and piping systems shall be completely balanced by the adjustment of the plug cocks, globe valves or other control devices, to obtain the flow quantities indicated on the design drawings.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for testing and balancing.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

E. Examine equipment performance data including fan and pump curves.

F. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and equipment with functioning controls is ready for operation.

G. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected, configured by the controls contractor, and functioning.

H. Examine strainers to verify that mechanical contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.

I. Examine two-way valves for proper installation and function.

J. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Prepare system-readiness checklists, as described in the "AABC National Standards for Total System Balance," for use by systems installers in verifying system readiness for TAB. These shall include, at a minimum, the following:

1. Airside:

a. Ductwork is complete with terminals installed.
b. Volume, smoke and fire dampers are open and functional.
c. Clean filters are installed.
d. Fans are operating, free of vibration, and rotating in correct direction.
e. Variable-frequency controllers' start-up is complete and safeties are verified.
f. Automatic temperature-control systems are operational.
g. Ceilings are installed.
h. Windows and doors are installed.
i. Suitable access to balancing devices and equipment is provided.

2. Stream Systems:
a. Piping is complete with terminals installed.
b. Systems are flushed, filled and air purged.
c. Strainers are pulled and cleaned.
d. Control valves are functioning per the sequence of operation.
e. Shutoff and balance valves have been verified to be 100 percent open.
f. Variable-frequency controllers' start-up is complete and safeties are verified.
g. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL REQUIREMENTS

A. At a minimum, measure, adjust and report the following:

1. Fans:
a. Inlet and outlet pressure
b. Air flow
c. Fan speed
d. Motor amps and KW
2. Ductwork Systems:
a. Air flow at each inlet and outlet.
b. Blade angles at all adjustable diffusers.
c. Filter pressure drop.
d. Outside air percentage at minimum and maximum setting.
e. Air flow at supply, return, outside air and exhaust mains to determine total air flow.
3. Coils:
a. Air flow.
b. Inlet and outlet air static pressure.
c. Inlet and outlet air temperature.
d. Water flow.
e. Inlet and outlet water pressure.
f. Inlet and outlet water temperature.
g. Inlet steam pressure
h. KW draw on electric coils.
4. Radiation and Convectors:
a. Inlet and outlet water temperature
b. Air temperature (room)
c. Water flow
5. Packaged VRF systems
a. Evaporators
1) At full heat: (Check at minimum outside air):
a) EAT

b) LAT
2) At full cooling: (Check at minimum outside air):
a) EAT (DB/WB)
b) LAT (DB/WB)
c) Minimum air flow rate.
b. Condenser
1) Ambient temperature
2) Suction and discharge pressures
3) Oil pressure
4) Compressor amps and KW
5)
6. Packaged Air Conditioning Units:
a. Perform tests for individual components present in units in accordance with specific requirements above.
b. At full heat: (Check at minimum outside air):
1) EAT
2) LAT
c. At full cooling: (Check at minimum outside air):
1) EAT (DB/WB)
2) LAT (DB/WB)
3) Ambient temperature
4) Suction and discharge pressures
5) Oil pressure
6) Compressor amps and KW
7) Minimum air flow rate.

B. Refer to other sections of these specifications for additional requirements.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Scope: All air systems are to be balanced.

B. Before any adjustments are made, check for:

1. Dirty filters, coils, or air intakes
2. Duct leakage
3. Filter leakage
4. Damper leakage, or blockage
5. Equipment vibrations
6. Correct damper operation

C. Simulate a pressure drop across filters equal to that when 50% loaded with dust.

1. Check fan motor amps with clean filters and simulated loaded filters, and report.

D. Procedure:

1. Measure and report all supply, return, exhaust, and outside air systems by means of (4) four methods:
a. Individual air inlets and outlets.
b. Pitot traverses of main supply, return, exhaust and outside air ducts.

c. Rotating valve or velocity grid traverse of coils or filters.
d. Plot operating point on fan curve. Include compensation for effects of altitude and inlet vanes.

2. Above measurements shall be made with system in normal, full load condition.
   a. Systems with economizers shall be measured at minimum outside air and 100% outside air.
   b. Systems with 100% outside air capability or evaporative cooling sections shall be measured at maximum outside air.
   c. VAV systems shall be measured at the zone level at maximum air condition, and at the main at the system diversity condition.
3. Make main duct traverses or coil/filter traverses and report operation at all other operating conditions (as applicable).
   a. Economizer operation
   b. Unoccupied mode
   c. Smoke evacuation mode
   d. Pre-cool mode
   e. Fail over mode
   f. Two-speed fans
   g. All VAV terminals driven to maximum position
4. Set fan speed such that under no condition will the motor exceed the service factor rating when operating in any of the above possible modes.
5. Measure fan motor amps in each of the above possible operating modes (clean filters).

E. Adjust Air Systems to provided proper air pressure relationships as shown by relative air quantities or as indicated on the drawings.

1. Review drawings for room by room pressure relationships and use a smoke candle to prove proper relative air flow.

F. Adjust distribution system for uniform space temperatures free from objectionable drafts and noise.

1. Division 23 33 00 to provide orifice plates or dampers where required.

G. Exchange sheaves and belts as required to adjust the RPM of all fans so they handle specified air quantity.

H. Set minimum outside air quantities.

I. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

J. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.

K. For variable-air-volume systems, develop a plan to simulate diversity.

L. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

M. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

N. Verify that motor starters are equipped with properly sized thermal protection.

O. Check condensate drains for proper connections and functioning.

P. Check for proper sealing of air-handling-unit components.

Q. Refer to other sections of these specifications for additional requirements.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Retain this article if using constant-volume air systems.

B. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

C. Measure total airflow.

1. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
2. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
3. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
4. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

D. Measure fan static pressures as follows:

1. Measure static pressure directly at the fan outlet or through the flexible connection.
2. Measure static pressure directly at the fan inlet or through the flexible connection.
3. Measure static pressure across each component that makes up the air-handling system.
4. Report any artificial loading of filters at the time static pressures are measured.

E. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

F. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust sub-main and branch duct volume dampers for specified airflow.
3. Re-measure each sub-main and branch duct after all have been adjusted.

G. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure airflow at all inlets and outlets.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after all have been adjusted.

H. Verify final system conditions.
1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust, if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located 2/3 of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control setpoint so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
   a. Adjust controls so that terminal is calling for maximum airflow (note some controllers require starting with minimum airflow. Verify calibration procedure for specific project).
   b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
   c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
   d. Adjust controls so that terminal is calling for minimum airflow.
   e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
   f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.
   g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

B. After all terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.

2. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
3. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
4. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
5. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

C. Measure fan static pressures as follows:

1. Measure static pressure directly at the fan outlet or through the flexible connection.
2. Measure static pressure directly at the fan inlet or through the flexible connection.
3. Measure static pressure across each component that makes up the air-handling system.
4. Report any artificial loading of filters at the time static pressures are measured.

D. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

1. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
2. Verify all terminal units are meeting design airflow under system maximum flow.

E. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to controls contractor.

F. Verify final system conditions as follows:

1. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm total airflow is within design.
3. Re-measure all final fan operating data, rpms, volts, amps, static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.
6. Verify tracking between supply and return fans.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Scope: Balance all hydronic systems.

B. Prepare test reports for pumps, coils, heat exchangers and other equipment. Obtain approved submittals and any manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

C. Verify that hydronic systems are ready for testing and balancing:

1. Check liquid level in expansion tank.
2. Check that makeup water-has adequate pressure to highest vent.

3. Check that control valves are in their proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

D. Before any adjustments are made:

1. Check temperature control valve operation.
2. Check pump rotation.
3. Adjust pressure reducing valve.
4. Remove any roughing strainer screens in systems.

E. Using system flow meters, adjust the quantity of fluid handled by each pump and supplied to each coil, piece of radiation, heat exchanger, cross-over bridge, bypass, etc., to meet design requirements.

F. Procedure:

1. Measure and report all hydronic and domestic water recirculation systems by all of the below means which are applicable.
   a. System, pump, branch, or terminal flow measuring stations.
   b. Terminal or heat exchanger pressure drop, compare to submittal data.
   c. Plot operating point on pump curve. Include compensation for effects of temperature, viscosity and density.
2. Above measurements to be made and reported at full heating/cooling load.
   a. For 3-way valve terminals/heat exchangers set bypass flow to equal coil flow.
   b. For primary/secondary systems, set crossover/bridle to have constant flow at all conditions.

G. Refer to other sections of these specifications for additional requirements

3.9 FIELD TESTING OF HYDRONIC SYSTEMS

A. During construction properly cap or plug all lines so as to prevent the entrance of sand, dirt, etc. The system of piping shall be blown through wherever necessary after completion (for the purpose of removing grit, dirt, sand, etc., from all equipment and piping), for as long a time as is required to thoroughly clean the apparatus.

B. Use anti-freeze solution for piping to be tested in winter.

C. All piping shall be tested as hereinafter specified. Tests shall be made after erection and before covering is applied or piping painted or concealed and as sections of mains and groups of risers are completed. The extent of the work completed before pressure tests are made shall be determined by the Architect.

D. All piping shall be tested to a hydrostatic pressure at least 1-1/2 times the maximum designed working pressure unless a higher pressure is required elsewhere (but not less than 50 psi) for a sufficiently long time to detect all leaks and defects; and after testing shall be made tight in the most approved manner. Tests shall be repeated once after leaks and defects have been repaired. When automatic-control valves and similar devices are incapable of withstanding test pressures applied to piping, such devices shall be removed, or otherwise protected during tests.

After completion of such tests, devices shall be installed and tested with the operating medium to operating pressures.

E. The following systems shall be tested for four consecutive hours and proved tight. Leaks shall be remedied by replacing defective work. Test shall be performed at 1-1/2 times working pressure unless a higher pressure is required elsewhere; minimum pressures listed in table below.

Item	Hydrostatic Field Test
Low pressure steam and condensate piping	100 psi
Overflow and drain	50 psi
Cold Water (domestic)	100 psi
Hot water heating	100 psi
Chilled water / Dual temperature water	100 psi
Vent - water discharge	100 psi

F. Leaks appearing during the various pressure tests shall be corrected by replacing all defective materials or welds and subsequent tests shall be made until the piping is found perfect. Caulking of screwed joints or peening of welds is prohibited. Wherever it is necessary to cut out a weld and the ends of the pipe cannot be conveniently brought together, then a short piece of pipe shall be fitted in and welded as approved by the Architect.

G. Provide all other tests required by Building Department, Fire Department and other Authorities having jurisdiction.

H. Running Test of Piping Systems:

1. When directed, any section of the work, after it has been completed and otherwise satisfactorily tested, shall be put in actual operation and operated for a period of two days of 24 hours each, during which time any defects which may appear shall be remedied and any adjustment which may be necessary shall be made.
2. During the time of the tests, repack all valves, make all adjustments and otherwise put the apparatus in perfect condition for operation, and instruct the Owner's representative in the use and management of the apparatus.

3.10 PROCEDURES FOR STEAM SYSTEMS

A. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

B. Check settings and operation of each safety valve. Record settings.

C. Verify the operation of each steam trap.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.

2. Motor horsepower rating.
3. Motor rpm.
4. Phase/Hertz (Hz)
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test the manual bypass of the controller to prove proper operation.

3.12 PROCEDURES FOR COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, fan-coil units, etc.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.13 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.

3. Check the condition of filters.
4. Check the condition of coils.
5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed.
2. Verify that the indicated airflows of the renovated work result in fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. Adjust fan speeds within the limits of the installed sheaves and belts to achieve design airflow.
4. Balance system to design airflows indicated.

3.14 EXISTING TO REMAIN DUCTWORK

A. Prior to the start of any demolition work that alters the duct configuration of an air handler or fan the HVAC contractor shall take flow and pressure readings on all duct branches and\or diffusers that will remain in service after alterations. Readings shall measure the existing air flow and static pressure at each location so that flow and pressure in branch can be restored after completion of work. All flow and pressure readings shall be provided to the engineer and made available to future balancing contractors for use on this project to reduce the need to re-balance all diffusers\registers\grilles on systems not being altered. Any contractor removing existing ductwork prior to the completion of the pre-demolition flow and pressure readings shall be responsible for re-balancing all diffusers and branch ductwork downstream of the point of the alteration.

B. New balancing dampers will be required at all locations where a new duct main serves an existing to remain branch, main or diffuser. In locations where an existing and functional volume damper is being removed or does not exist at the point of the connection of the new duct to the existing duct a new balancing damper shall be provided at the point of the new connection.

C. After the completion of the duct alterations the new and existing damper(s) and fan(s) shall be balanced to provide indicated flow at all new diffusers and match pre-demolition flow measurements at all existing to remain distribution systems.

3.15 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak conditions, the engineer may request a temperature recheck to further verify performance at near-peak conditions.

B. Duct Leakage Testing:

1. Witness the duct pressure testing performed by the mechanical/installing contractor.
2. Verify that proper test methods are used and that leakage rates are within specified tolerances.
3. Report any deficiencies observed.

C. Controls Verification

1. In conjunction with system balancing perform the following:
   a. Work with the temperature control contractor to ensure the system is operating within the design limitations, and gain a mutual understanding of intended control performance.
   b. Confirm that the sequences of operation are in compliance with the approved drawings.
   c. Verify that controllers are calibrated and function as intended.
   d. Verify that controller setpoints are as specified.
   e. Verify the operation of lockout or interlock systems.
   f. Verify the operation of all valve and damper actuators.
   g. Verify that all controlled devices are properly installed and connected to the correct controller.
   h. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
   i. Verify the location and installation of all sensors to ensure they will sense only the intended temperatures, humidity, or pressures.

3.16 FINAL TEST AND BALANCE REPORT

A. Provide a general information sheet listing:

1. Instruments used:
   a. Most recent calibration date.
2. Method of balancing.
3. Altitude correction.
4. Manufacturer’s performance data for all air devices used.

B. Provide data sheets for all equipment, including motors and drives, listing:

1. Make
2. Size
3. Serial number
4. Capacity Rating
5. Amperage
6. Voltage input
7. Thermal heater size for each motor

8. Operating speed of driver and driven devices
9. Any additional pertinent performance data

C. Include design and final values for all items listed in Detailed Requirements, and totals for each system.

D. Provide data sheets showing:

1. Air flow at each inlet and outlet
2. Instrument used
3. Velocity reading
4. Manufacturer's free area factors

E. Provide recap sheet with explanation for each device not meeting specified performance. Contractor shall be responsible for correcting all deficiencies noted in the TAB report. Upon completion of correction of deficiencies, the TAB contractor shall retest all devices and provide an updated report.

F. Provide a set of prints with equipment, inlets and outlets marked to correspond to data sheets.

END OF SECTION 230593

SECTION 230700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Insulation.
2. Jackets, coatings and protective finishes.
3. Sealers, mastics and adhesives.
4. Fitting covers.
5. Manufacturer's installation details for fire rated duct wrap.

1.2 FLAME AND SMOKE RATINGS

A. Provide insulation tested on a composite basis (insulation, jacket, covering, sealer, mastic and adhesive) complying with the following for:

1. Flame Spread: 25 or Less
2. Smoke Developed: 50 or Less
3. Method: ASTM E84 (NFPA 255), UL 723

B. Accessories such as adhesives, mastics, cements, tapes and cloths for fittings shall have component ratings as listed above. All products shall bear UL labels indicating the above are not exceeded.

1.3 PRODUCT DELIVERY

A. Deliver insulation products in factory containers bearing manufacturer's label showing fire and smoke hazard rating, density and thickness.

B. Protect insulation against, dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

C. Store insulation in original wrappings and protect from weather and construction traffic.

1.4 DEFINITIONS

A. Exposed Location: Located in mechanical rooms or other areas exposed to view.

B. Concealed Location: Locations not exposed to view, such as pipe chases, furred spaces, attics, crawl-spaces and above wall to wall suspended ceilings.

1.5 STANDARDS

A. Comply with the latest edition of National Commercial and Industrial Insulation Standards.

B. Provide certifications or other data as necessary to show compliance with these Specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. Manufacturers:

1. Design Basis: Johns-Manville
2. Other Acceptable Manufacturers:
   a. Armacell
   b. Foster
   c. Childers
   d. Owens-Corning
   e. Knauf
   f. KFlex USA
   g. Imcoa
   h. Pittsburgh Corning

B. Materials:

1. Fiberglass Pipe Insulation with Vapor Barrier: Johns-Manville Micro-Lok heavy density pipe insulation with AP-T jacket or Owens-Corning Fiberglass Corp. ASJ/SSL-II.
2. Fiberglass Pipe Fitting Insulation: Johns-Manville “Zeston” fitting covers with factory-cut fiberglass insulation insert. Insulation blanket with foil tape and tie-wire will not be acceptable.
3. Flexible Unicellular Pipe Insulation: Armstrong Armaflex, II or Therma-cel By Nomaco.
4. Cellular glass with vapor barrier coating: Pittsburgh Corning FoamGlass.
5. Rigid Closed Cell Insulation: ITW Insulation Trymer 2000 XP (not for use indoors).
6. Vapor Barrier Mastic: Foster 30-65 or Childers CP-34; permeance shall be 0.03 perms or less per ASTM E96. Mastic must meet California Dept of Public Health (CDPH) Standard Method Ver. 1.1, 2010 Small Scale Environmental Chamber Test for VOCs for CA Specification 01350 and LEED IEQ 4.2.
7. Weather Barrier Mastic: Foster 46-50 or Childers CP-10/11. For use on hot service pipe and ducts.
8. Lagging Adhesive: Foster 30-36 or Childers CP-50AMV1.
9. Fiberglass Adhesive: Foster 85-60 or Childers CP-127.
10. For hot pipe insulation material shall be rated at 650˚F.

C. Thickness: (Thickness listed below are minimum required. Provide thickness required by Local Building or Energy Codes).

1. Hydronic Piping and Steam:

Piping Insulation Thickness (inches)							
Operating Temperature	Insulation Conductivity[a]		Pipe Size				
°F	Btu*in/ (h*ft^2*F)	Mean Rating Temperature, F	<1"	1" to < 1-1/2"	1-1/2" to < 4"	4" to < 8"	≤ 8"
Chilled Water							
40°F - 60°F	0.21-0.27	75	1.5	1.5	1.5	1.5	1.5
Heating Water							
141°F - 200°F	0.25-0.29	125	1.5	1.5	2	2	2
Low Pressure Steam and Condensate (less than 15psig)							
201°F - 250°F	0.27-0.30	150	2.5	2.5	3	3	3

a. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$T = r\{(1+t/r)^{K/k}-1\}$

where:

T: minimum insulation thickness,

r: actual outside radius of pipe,

t: insulation thickness listed in the table for applicable fluid temperature and pipe size,

K: conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu x in/h x ft^2 x F) and

k: the upper value of the conductivity range listed in the table for the applicable fluid temperature.

1. Refrigerant Piping (Liquid, Suction and Hot Gas) and AC Condensate
   a. Up to 1" – ¾"
   b. Above 1" – 1"
2. Heat Traced Piping
   a. Size 2" and smaller: 1"
   b. Size 2½" and larger: 2"
3. Condensate Drain Piping: 1"

B. Application: Unless otherwise indicated, use the following:

1. Inside, concealed: Fiberglass pipe insulation with vapor barrier.
2. Inside, exposed: Fiberglass pipe insulation with vapor barrier and PVC jacket (jacket not required in mechanical rooms).

a. A vapor barrier mastic compatible with the PVC shall be applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. The PVC fitting cover is then applied and shall be secured with pressure sensitive pearl gray Z-Tape along the circumferential edges. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side.
b. 2 or more layers of the Hi-Lo Temp insulation inserts shall be applied with the first layer being secured with a few wrappings of fiberglass yarn.
c. Refrigerant systems and cold systems in severe ambient conditions: Fittings shall be insulated to a full thickness the same as the adjacent pipe insulation, with insulation which has been mitered to conform to the PVC fitting cover. An intermediate vapor barrier mastic and reinforcing mesh compatible with the PVC shall be applied directly onto the insulation, completely sealing the insulation. The PVC fitting cover is then applied and shall be secured with pressure sensitive pearl gray Z-Tape along the throat seam and the circumferential edges overlapping itself 2" on the downward side.
d. Qualifications for Using Insulation: Use one Hi-Lo Temp insert for each additional 1" of pipe insulation.
e. Fitting Cover: the temperature of the PVC fitting cover must be kept below 150˚F by the use of proper thickness of insulation and by keeping the PVC cover away from contact with, or exposure to, sources of direct or radiant heat.

3. Outside, protected: Fiberglass pipe insulation with vapor barrier and aluminum jacket.
4. Outside, exposed to weather: Rigid closed cell pipe insulation with aluminum jacket.
5. All fittings, valves and flanges for pipe sizes 3" and below shall be insulated with preformed molded fiberglass insulation of same thickness as the adjoining pipe insulation, secured with No. 20 gauge galvanized annealed steel wire covered with Zeston 2000 molded PVC fitting covers as manufactured by Manville, or equal.
6. All fittings, valves and flanges for pipe sizes 4" and larger shall be insulated with fabricated mitered segments of pipe insulation of same thickness as the adjoining pipe insulation, secured with no. 20 gauge galvanized annealed steel wire and covered with Zeston 2000 molded PVC fitting covers as manufactured by Manville or equal.
7. Direct contact between pipe and hangers will not be accepted. Hangers shall pass outside of a metal saddle which shall cover a section of high density insulation of sufficient length to support pipe without crushing insulation. Hangers shall not pierce insulation and all vapor barriers shall be unbroken and continuous. High density insulation shall be one of the following:
   a. Foam glass.
   b. Fiberglass, high density, minimum of 7 lb. material or heavier.
   c. High density calcium silicate insulation. See Part 3 of this Section for high density insulation lengths.
8. At pipe supports insulation shield protection saddles and matching hanger shall be used.
9. All strainers for chilled water and insulated condenser water piping shall be insulated and boxed in with galvanized sheet metal cover, and insulation shall be made removable.
10. The Contractor shall have the option to use Armaflex as made by Armstrong Co. pipe insulation in lieu of fiberglass hereinbefore specified for refrigerant, chilled, and hot water piping insulation in fan coil units. Pipe insulation shall meet flame spread index of 25 and smoke density of 50 when tested in accordance with ASTM-E-84.
11. Provide vapor barrier dams at locations and intervals recommended by the insulation manufacturer and as described in this specification.

C. Flexible elastomeric insulation (25/50 flame spread/smoke developed index) is acceptable in lieu of fiberglass on cold piping (roof leaders, chilled water, condensate drains from cooling units).

1. Use pre-molded roll on pipe sizes 3.5" and below.
2. Use either pre-molded roll or sheet on pipe sizes 4" and above, adhere insulation on 100% of the pipe. This requirement exceeds the typical industry standard of adhering to lower one-third of pipe on horizontal runs.
3. Match thickness of fiberglass insulation on all pipe sizes. Provide multiple layers when a single layer of material cannot accomplish required thickness.
4. No exposed cross section edges are permitted.

2.2 DUCT INSULATION

A. Manufacturer:

1. Design Basis: Johns Manville
2. Other Acceptable Manufacturers:
   a. Owens-Corning
   b. Certainteed
   c. Knauf

B. Materials:

1. Flexible fiberglass Ductwork Insulation: Johns-Manville Microlite XG, with FSK factory applied foil-scrim-kraft vapor barrier facing, with maximum K factor of 0.25 at 75˚F mean temperature.
2. Rigid Fiberglass Ductwork Insulation: Johns-Manville 800 Series, Spin-Glas Type 814, with FSK factory applied foil-scrim-kraft vapor barrier facing, with maximum K factor of 0.23 at 75˚F mean temperature.
3. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles, and similar accessories as recommended by the insulation manufacturer for the applications indicated.
4. Cellular glass: Pittsburgh Corning with vapor barrier.

C. Thickness: (Thickness listed below are minimum required. Provide thickness required by Local Building or Energy Codes).

Ductwork Insulation				
Location	Exposed/Concealed	Insulation Type	R-Value	Thickness
Supply Ductwork (unlined)				
Indoor	Exposed	Rigid	R-6	1½”
Indoor	Concealed	Flexible	R-6	2”
Indoor, Unconditioned Space	Exposed	Rigid	R-6	1½”
Indoor, Unconditioned Space	Concealed	Flexible	R-6	2”
Outdoor	See Outdoor Duct Insulation Section			
Return Ductwork (unlined)				
Indoor	Exposed	Rigid	R-6	1½”
Indoor	Concealed	Flexible	R-6	2”
Indoor, Unconditioned Space	Exposed	Rigid	R-6	1½”
Indoor, Unconditioned Space	Concealed	Flexible	R-6	2”

Ductwork Insulation				
Location	Exposed/Concealed	Insulation Type	R-Value	Thickness
Outdoor	See Outdoor Duct Insulation Section			
Outside Air Ductwork (unlined)				
Indoor	Exposed	Rigid	R-6	1½"
Indoor	Concealed	Flexible	R-6	2"
Indoor, Unconditioned Space	Exposed	Rigid	R-6	1½"
Indoor, Unconditioned Space	Concealed	Flexible	R-6	2"
Outdoor	See Outdoor Duct Insulation Section			
Exhaust Air Plenum or Ducts Behind Louver up to Automatic Damper (unlined)				
Indoor	Exposed	Rigid	R-6	1½"
Indoor	Concealed	Flexible	R-6	1½"

D. Application:

1. Where energy codes require additional insulation over that listed above, provide insulation in accordance with those codes.
2. The Contractor shall have the option to use the following material: Insulation for round ducts shall be of thickness noted above and shall be fiberglass Bend-a-Board having a factory applied ASJ vapor barrier jacket secured with stables and ASJ pressure sensitive tape. Bend-a-Board is a 3.00 p.c.f. board cut into strips, adhered to jacketing it must have a UL label.
3. Adhere insulation to duct with Foster water based, fire resistant adhesive 85-60, Chiders CP-127, or approved equal, applied in 3 inch wide transverse strips at 8 inch intervals. Insulation shall be butted with facing overlapping all joints at least 2 inches and sealed with Foster fire resistant adhesive 85-60, Childers CP-127, or approved equal. For insulation with vapor barrier use Foster fire resistant vapor barrier adhesive or equal and joints without tabs shall be firmly sealed with aluminum foil tape adhered with same adhesive. Secure insulation with 16 gauge copperclad wire spaced not more than 12 inches on center.
4. Additionally, secure insulation to bottom of rectangular ducts over 24" wide with welded pins or stick clips on 18" centers coated with a vapor barrier coating.
5. Rigid duct insulation shall be fastened to duct with 12 gauge welded pins and washers, or equivalent as approved. Fasteners shall be spaced 12 to 18 inches on center, a minimum of two rows per side of duct. Secure insulation in place with suitable speed washers firmly embedded in insulation, or push a self-locking cap over pin after coating with fitting mastic type C by Owens-Corning or equal. For rigid duct insulation, seal all joints, breaks and impressions with Foster water based, fire resistant vapor barrier mastic Foster 30-65, Childers CP-34, or approved equal, and apply 5" wide joint sealing tape to all joints. All surface must be clean and dry before applying tape and mastic.
6. Insulation for exposed round ductwork shall be of the same material as specified for concealed ductwork and shall be covered with glass cloth or all service jacket smoothly adhered with Foster 85-60 or Childers CP-127 adhesive. Seal joints with 5" wide tape.

E. Acoustical Duct Lagging (Office space)

1. Manufacturers:

a. Design Basis: Kinetics Noise Control
b. Other acceptable manufacturers:
1) Sound Seal
2) The Proudfoot Company
3) Acoustical Solutions
c. Model: PA-410 GB, black vinyl-coated fiberglass cloth sheet fully bonded to a minimum 1” thick fiberglass blanket, nominal density of 3.0pcf, install so jacket edges overlap by minimum of 6”. Minimum STC-27 tested by independent laboratory in accordance with ASTM E90 and E413. Minimum insertion loss (IL) value at 500Hz shall be 23. Lagging shall meet IMC flame/smoke ratings in accordance with ASTM E84.
d. Duct lining shall be rated to prevent fiber erosion at air velocities up to 4,000 FPM and shall have a minimum density of 1.5 pounds per cubic foot. The liner must be installed with sheet metal nosing at the leading edge. Exposed edges-including butt joints – shall be sealed with mastic.
e. Lining shall be contained between outer wall of duct and perforated metal inner liner of material to match the duct material. Perforations shall not exceed 3/32” diameter, free area shall be approximately 22%. Metal liner need not be perforated at fittings. Provide continuous mylar liner between the perforated liner and insulation to prevent the erosion of the insulation.
Provide transitions at end of insulated sections to adapt duct liner size to dimension of unlined ductwork. Liner and transition shall be concentric for low pressure drop.
f. Thickness shall be per thickness required for externally insulated ductwork of same function and location.

2.3 OUTDOOR DUCT INSULATION

A. Manufacturers:

1. Design Basis: Armstrong
2. Other Acceptable Manufacturers:
a. Johns-Manville
b. Nomaco

B. Materials:

1. Model: Armaflex
a. Description: Flexible, cellular, elastomeric foam.
b. Form: Sheet
2. Paint: Armaflex Finish
a. Description: Vinyl lacquer. Contractor must coordinate color of vinyl lacquer with Architect. Submit color chart to Architect for his review.
3. Adhesive: Armstrong 520.
4. Cellular glass: Pittsburgh Corning with vapor barrier.
5. Weatherproofing Finishes for Outdoor Duct Insulation:
a. VentureClad 1579CW Jacketing System, or equal. 13 Ply, 0.45 mm minimum thickness.

b. Color selected by architect

C. Application:

1. All outdoor supply, return and transfer air ducts that are specified with acoustical duct lining shall be provided with 2” duct lining (minimum R=8).
2. All outdoor supply, return, and transfer air ducts that are not specified to have acoustical lining shall be insulated with two layers of one inch thick sheet on the exterior.
3. Jacketing shall be applied with minimum 2 inch overlaps facing down from the weather and the jacketing shall be secured with aluminum bands 1/2 inch by 0.020 inches and aluminum wing seals applied on 12 inch centers, with bands applied directly over butt overlaps or with Pli-Grip Rivets. Where jacketing is cut out or abuts an uninsulated surface, the joint shall be sealed with Foster 95-44, Childers CP-76, or Insul-Coustic Sure-Joint 405.
4. Over the insulated surface apply a tack coat of Foster 46-50, Childers CP-10/11, or Vi-AC Mastic and imbed in it a layer of glass cloth. A smooth finish coat of weather barrier mastic shall be applied to the entire area so that the total film thickness is a minimum of 1/8 inch. Provide high point at center, so that no water accumulation will occur.

2.4 EQUIPMENT INSULATION

A. Manufacturer:

1. Design Basis: Johns Mansville
2. Other Acceptable Manufacturers:
   a. Armstrong
   b. Certainteed
   c. Owens-Corning
   d. Knauf
   e. Pittsburgh Corning

B. Materials:

1. Model: Pipe and tank insulation.
   Description: Flexible board type insulation. 3 PCF glass fiber insulation with all purpose jacketing. Maximum thermal conductivity .32 BTU-IN/(hr-FT^2-ºF) at 150ºF. Glass fibers oriented such that insulation will conform to rounded shapes while maintaining high compressive strength.
2. Model: Johns-Manville 800 series, spin glass type 814.
   Description: 3 PCT density rigid glass fiberboard, with all purpose jacketing. Maximum thermal conductivity .27 BTU-IN/hr-FT^2--ºF).
3. Jacketing Material: PVC or aluminum jacketing material, except as otherwise indicated. Seal all joints.
4. Fiberglass: Johns-Manville Micro-Lok 850 insulation with APT jacket.
5. Flexible Unicellular Insulation: Armstrong Armacell sheet form.

C. Application:

1. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, metal covers, adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications

indicated.

2.5 FIRE RATED DUCT WRAP/INSULATION

A. Manufacturers (all components to be by one manufacturer):

1. 3M
2. Unifrax
3. Nelson
4. Thermal Ceramics
5. Pyroseat
6. Vesuvius
7. ETS Schaefer

B. Materials:

1. Lightweight, non-asbestos, high temperature inorganic ceramic fiber blanket wrap.
2. Insulation to be fully encapsulated in reinforced foil.
3. Sufficient thickness to provide two (2) hour fire resistant enclosure.
4. Fibers to be non-carcinogenic and soluble in human lung tissue.
5. Zero clearance to combustibles rating.
6. As an alternate to manufactured wrap systems the contractor may, with the engineers approval, utilize 2" thick calcium silicate 11 PFC minimum density insulation wired on and finished with 1/2" thick hard plaster laid over chicken wire and troweled smooth. Finish with two (2) coats of cement over hexagonal wire. Wire shall be copperclad steel.

C. Listings and Testing :

1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials
   Surface burning characteristics:
   a. Flame Spread: 0
   b. Smoke Developed: 0.
2. ASTM E814: Standard Test Methods for Fire Tests of Through-Penetration Firestops
3. ASTM E119: Standard Test Methods for Fire Tests of Building Construction Materials
4. NFPA 96.
5. NFPA 101.
6. Submit written approval from authority having jurisdiction for use of system at specified clearance.
7. Bureau of Standards and Appeals MEA #.

D. Application:

1. Wrap duct supports for two (2) hour rating.
2. Install per manufacturer’s recommended installation guidelines.
3. Provide Manufacturers approved transition between fire wrap and gypsum board rated enclosures where both systems are used. Do not transition from gypsum enclosure system back to fire wrap, regardless of what may be shown on drawings.
4. Use bands and/or welded pins as required. Adhesives are not acceptable.
5. Provide rated access doors (as required) insulated to maintain two (2) hour rating and required clearance.

6. Provided fire barrier sealant, tape, rods, pins, clips, bands and other components as required to provide fully functioning system.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify acceptability of all materials which are to be used in air plenums (above ceiling, etc.). Materials must meet all requirements of Local Building Code and Authority having jurisdiction.

B. Insulation Packing:

1. Piping :
   a. Wherever piping penetrates walls, partitions, floor slabs, etc., the space between the piping and the sleeve shall be packed with mineral wool and sealed with approved type non-hardening fire resistant caulking compound for sleeves through exterior walls.
2. Ductwork:
   a. Provide 1/2" thick rigid fiberboard sleeve wherever ductwork penetrates walls, floor slabs, partitions, etc. Space between duct and wall sleeve and between duct and slab opening shall be tightly packed with mineral wool and sealed with approved type non-hardening fire resistant caulking compound.
3. Material:
   a. Packing material shall be rockwool insulation as manufactured by United Stated Gypsum Co. or equal and shall comply with Fed. Spec. HH-1-558, Form A, Class 4, K=0.24, melting point 2000˚F.

C. Contractor shall examine location where this insulation is to be installed and determine space conditions and notify the Architect in writing of conditions detrimental to proper and timely completion of the Work.

D. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. Install insulation in accordance with manufacturer's written instructions and recommendations, and with recognized industry practices, to ensure that insulation complies with requirements and serves intended purposes.

B. Coordinate with other work as necessary to interface installation of insulation with other components of systems.

C. All insulating materials shall be applied only by experienced workmen, in accordance with the best covering practice. All piping, duct or equipment shall be blown out, cleaned, tested and painted prior to the application of any covering. Adhesives, sealers and mastics shall not be applied, when the ambient temperature is below 40˚F., or surfaces are wet.

3.3 PIPE INSULATION

A. Insulate the following:

1. Heating piping.
2. Chilled water piping.

3. Refrigerant suction and hot gas bypass lines.
4. Steam and condensate piping.
5. All existing piping which is currently insulated and which is modified as a result of this work.
6. Condensate drain piping.

B. Installation:

1. Install insulation on pipe system subsequent to testing and acceptance of tests.
2. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete the run. Do not use cut pieces or scraps abutting each other.
3. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered. Provide vapor barrier joint sealant on all butt joints of cold pipe insulation.
4. Extend piping insulation without interruption through pipe clamps, hangers, walls, floors and similar piping penetrations, except where otherwise indicated. Notched insulation will not be acceptable.
5. Install protective metal shields and saddles where needed to prevent compression of insulation. Refer to Section 23 05 29.
6. Except as noted, cover valves, flanges, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.
   a. Install factory-molded, pre-cut or job-fabricated units (at Installer's option), except where a specific form or type is indicated.
   b. Do not cover:
      1) Valve operators.
      2) Nameplates or identification tags.
   c. Provide removable access for:
      1) Strainers.
      2) Other components requiring access for service.
7. Mark location of unions and flanges covered by insulation with permanent paint or ink, or approved label.
8. Maintain integrity of vapor-barrier sealant and jacketing on insulation of cold pipes and protect to prevent puncture or other damage. Insulation on cold surfaces where vapor barriers are used shall be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold services shall be adequately insulated and vapor sealed to prevent condensation.
9. Inserts shall be installed at hangers for insulated piping. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths:

2-1/2" pipe size and smaller	6" long
3" to 6" pipe size	9" long

10. Provide 18 gauge galvanized metal shields between hangers or supports and pipe insulation. Form shields to fit insulation. Extend shields up to centerline of pipe. Make shields same length as that specified above for inserts.
11. Where insulation is specified for piping, insulate similarly all connections, vents, drains, and any piping connected to system.
12. Fill surface imperfections such as chipped edges, small joints or cracks and voids or holes with insulation material and smooth all such areas with a skim coat of insulating

cement.

13. Seal ends of sections with Foster 30-65 or Childers CP-34 vapor barrier mastic and reinforcing mesh to create moisture dams at:
    a. 20 ft. intervals.
    b. Valves and fittings.
    c. All hangers and supports.
14. Replace existing insulation removed or damaged because of work of this project.
15. Insulate new pipes and replace insulation on existing pipes to remain where insulation was removed or damaged by demolition or revisions.
16. Do not insulate steam traps.
17. Insulate between fingers of spiders in alignment guides.
18. Insulate between pipe and pipe saddle.
19. Perform all work in a neat and workmanlike manner. Poor work (as determined by Architect or Engineer) will be cause for rejection.
20. Specialties shall be insulated to match those of the systems to which they are connected.
21. No insulation shall be installed until the piping systems have been hydrostatically tested as specified elsewhere to the satisfaction of the Engineer.
22. Provide glass cloth and aluminum bands 18" on center on calcium silicate insulation jacket and flared-out staples on all fiberglass hot pipe insulation. Tape vapor barrier joints and seams on all cold pipe insulation.
23. Provide insulation on all horizontal runs of condenser water piping running over occupied areas to avoid condensation on pipe surfaces during winter operation of the Water Side Economizer.
24. Provide extended valve stems to maintain vapor barriers on all chilled water valves as required.
25. In addition to the requirements above, provide ITW SARAN CX Vapor Retarder or vapor barrier mastic/reinforcing mesh on all Chilled Water vertical elbows.
26. When available, insulate fittings with factory pre-molded fittings of the same thickness as adjoining pipe insulation.
27. When pre-molded fittings are unavailable, use a hydraulic setting cement paste.
28. Clamps and anchors on cold piping shall be insulated. Full taping of pre-molded fittings is required.
29. Insulation at pipe strainer flanges shall be arranged for ease of servicing.
30. Insulation and vapor barriers shall be properly protected at all hangers and penetrations.
31. Insulated valves shall have extended handle stems so all operators or handles are outside of the insulation system. This is particularly true of high pressure steam piping.
32. Provide factory manufactured removable covers on all steam PRV’s, constructed with 2” TEMPMAT insulation, fiberglass cloth, stainless steel grommets, and stitching. Cold side shall be silicone impregnated for moisture and soiling resistance.
33. All refrigerant line accessories that are part of the suction and hot gas bypass refrigerant system (e.g. valves, vibration eliminators, P-traps, filters, etc.) shall be complete insulated.
34. All refrigerant insulation must be properly sized for the piping that it is being installed on.

    a. Insulation installed on horizontal runs of refrigerant piping will require that the insulation protection shield be installed between the insulation and the pipe hanger.
    b. All seams and joints in the insulation will be required to be sealed with the proper adhesive, for the product being use, to provide a continuous vapor barrier.
    c. Piping clamps that are in contact with the suction line are required to be covered with insulation.

d. All thermostatic expansion valve sensor bulbs are required to be covered with insulation.

3.4 DUCTWORK INSULATION

A. Insulate all ductwork except the following portions of ductwork:

1. Ducts and casings internally insulated or provided with sound absorptive lining.
2. All exhaust ductwork, except where otherwise noted.
3. Return air ductwork from air conditioning systems passing through air conditioned space and/or hung ceiling of air conditioned space.
4. Return air ductwork from heating and ventilating systems, where return air ducts pass through heated areas.
5. Exposed air conditioned supply and return air ducts in air conditioned spaces if same supply or return air ducts serve that area only.
6. Exposed supply air duct from heating and ventilating systems, if same duct serves that area only.

B. Except where otherwise noted, all concealed rectangular and round ductwork shall be covered with flexible duct insulation with or without vapor barrier.

C. Install insulation materials with smooth and even surfaces, after inspection and release for insulation application. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Clean and dry ductwork prior to insulating.

E. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated.

F. Except as otherwise indicated, do not insulate lined ducts. However, extend duct insulation 12” beyond start of lining where lined ductwork meets insulated ductwork.

G. Maintain integrity of vapor-barrier on insulation of ducts carrying cold air, and protect it to prevent puncture and other damage. Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold services shall be adequately insulated and vapor sealed to prevent condensation.

H. Do not install covering before ductwork has been tested and approved.

I. The finish including any vapor barrier treatment shall lap adjacent sections at both the transverse and longitudinal joints and 3" strips of matching finish material shall be adhered at the transverse joints.

J. For Outdoor Armaflex Insulation:

1. Stagger joints on multilayer applications.
2. Locate joints at sides of ducts whenever possible.
3. Use 520 adhesive to attach insulation. Provide full coverage.
4. Seal all seams and joints with adhesive.
5. Maintain full thickness at standing seams and flanges by additional layer(s).

6. Cover flexible connections.
7. Extend covering to inside face of outside wall.
8. Finish with two coats of Armaflex finish or Foster 30-64 coating.

K. The installer of the ductwork insulation shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

L. Ductwork directly connected to ovens shall be insulated to the requirements for breeching.

M. The use of flexible elastomeric insulation on ductwork is permitted as an acceptable alternative to fiberglass. Insulation shall be adhered to 100% of the duct surface area.

3.5 EQUIPMENT INSULATION

A. Install insulation materials with smooth and even surfaces and on clean and dry surfaces, after inspection and release for insulation application.

1. Re-do poorly fitted joints.
2. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

B. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

C. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

D. Do not insulate handholes, cleanouts, ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

E. Insulation for factory-fabricated air handling units shall be furnished as part of units.

F. Cold Equipment (At or below ambient equipment):

1. Includes chilled, condenser water system equipment such as air release tanks, air separators, expansion tanks, flash tanks, vessels, etc.
2. Insulate air release tanks (air separators) with 2 inches of pipe and tank insulation or 1½ inches of [rigid fiber glass board] [cellular glass].
3. Vapor barrier to be provided on chilled water expansion tank, air separator and chemical treatment tank.
4. The Contractor shall have the option of using 2" thick fiberglass Bend-A-Board insulation with .016" thick aluminum jacket with lock seams at longitudinal seams and 1/2" aluminum bands 12" on center at traverse joints. Joints and jacket shall provide complete protection for the insulation.

G. Refrigeration Machines:

1. In general, the following areas on water chillers shall be insulated: the shell areas which are exposed to chilled water, suction connection, oil cooler, and water boxes (cooler section). The exact extent of these areas shall be recommended by the chiller manufacturer during the shop drawing submission. The insulation Sub-Contractor shall

be responsible for determining the area to be insulated subject to Engineers approval.

2. Insulate all cold surfaces, except the heads, with a 3" thickness in two 1-1/2" thick layers of Manville No. 815 "Spinglas" fiberglass insulation with factory applied FSK vapor barrier facing. The insulation shall have an average thermal conductivity not to exceed .22 BTU/inch per sq. ft. per degree F. per hour at a mean temperature of 75˚.
3. Insulation shall be securely banded in place with 1/2" x .015" galvanized bands, or secured with weld pins or stick clips with washers spaced 18" apart. Lap joints shall be secured with Manville Therm-Lok. All joints shall be staggered and sealed to prevent moisture penetration with a vapor barrier mastic, Benjamin Foster 30-35. Cut, score or miter insulation to fit contour of equipment.
4. Apply tack coat of Foster 30-65 or Childers CP-34 vapor barrier mastic at 2 gallon per 100 sq feet spray or brush. Embed Foster Mast a Fab or Childers Chil Glas #10 (10 x 10) into wet coating, smoothing to avoid wrinkles. Overlap reinforcing mesh seams at least 2". Apply a finish coat of vapor barrier mastic 2 gallons per sq. ft. by spray or brush to the entire fabric surface. Finish to be applied not later than one half hour after the tack coat.
5. Insulated removable and replaceable metal covers shall be used on the heads. Type and thickness of insulation for removable covers shall be similar to that used for the other cold surfaces.

H. Filters:

1. Prefilter, afterfilter housing and flow measuring devices shall be insulated same as ductwork.

I. Exterior Ductwork:

1. Ductwork outside of the building shall have weatherproof cover. Fan located inside or outside of the building shall have insulation similar to return air fans. If fan located outside of the building, provide weatherproofing.
2. Outside Air Intakes and Exterior Ducts: 2-inch thick rigid, fiberglass board, 6.0 pounds per cubic foot density, to a minimum R-value of 8, complete with insulation faced and anchored as described for exposed ductwork.

J. Insulate equipment to match adjoining piping insulation.

K. Outside Air Intakes and Exterior Ducts: 2-inch thick rigid, fiberglass board, 6.0 pounds per cubic foot density, to a minimum R-value of 8, complete with insulation faced and anchored as described for exposed ductwork.

3.6 FIRE RATED DUCT WRAP

A. Remove dirt and dust and clean all duct surfaces.

B. Install per manufacturers instructions and referenced standards. Where pins are required they shall be tack welded to duct.

C. Repair any damage in accordance with manufacturer’s instruction.

3.7 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily. Including units with vapor

barrier damage and moisture saturation. The insulation installer shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

3.8 ASBESTOS REMOVAL

A. It is understood and agreed that this work does not contemplate handling of, or design including use of, asbestos or any hazardous waste material. Therefore, Owner and Contractor agree to hold harmless, defend and indemnify consultant (A/E) for all claims, lawsuits, expenses or damages arising from or related to the handling, use, treatment, purchase, sale, storage or disposal of asbestos, asbestos products or any hazardous waste materials.

B. In the event asbestos is encountered the Contractor shall immediately cease work in the area of the asbestos shall contact the Owner for instructions.

C. Site Monitoring:

1. Follow Section 1910.1001 Code of Federal Regulations Title 29, Part 1910 (OSHA Asbestos Regulations).
2. Provide daily sampling during removal instead of at six month intervals.
3. Stop work and notify Architect immediately if levels exceed those of Subparagraphs b (2) or b (3) of regulations.

END OF SECTION 230700

SECTION 230900 - BUILDING AUTOMATION AND AUTOMATIC TEMPERATURE CONTROL SYSTEMS

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. This Section is coordinated with and complementary to the General Conditions and Supplementary General Conditions of the Work, wherever applicable to Mechanical Work.

B. Section 23 05 02 – Basic Mechanical Requirements shall apply.

1.2 DESCRIPTION

A. The work described under this division is for all labor, materials, and equipment required for the construction of the Building Management System (BMS or BAS/Automatic Temperature Control/ (ATC) system.

B. The system shall be complete in all respects, tested and ready for operation.

C. All materials, equipment and apparatus shall be new and of first-class quality.

D. Electrical Standards: Provide electrical products which have been tested, listed and labeled by Underwriters' Laboratories and comply with NEMA standards, The Building Code of the City of New York, and the National Electric Code.

E. "Operator" is defined as the Owner's representative designated to operate the BMS/ATC system after Owner acceptance.

F. The work includes the providing of all labor, materials, equipment, accessories, services and tests necessary to complete and make ready for operation by the Owner, a building automatic system as shown on the drawings and hereinafter specified.

G. The Building Automation System shall be provided by the same manufacturer as the automation temperature controls.

H. The Automation System subcontractor shall furnish and install all equipment, accessories, wiring and instrument piping required for a complete and functioning system.

I. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use.

J. The automation system shall be of a fully modular architecture permitting expansion by adding computer memory, application software, operator peripherals and field hardware.

K. If expansion of the automation system necessitates greater computer processing power, it shall be possible to transfer all existing software and data base, both vendor supplied and user-defined, to a new more powerful computer. This shall be accomplished by using removable, compatible disk cartridges.

L. Systems which require the existing user-defined data base to be reentered through the operator's terminal shall not be acceptable.

M. Although fire alarm and security points will not be installed or monitored, initially the system shall be installed completely ready to receive or accept these points at a later date without additional central hardware or software.

N. The system as specified shall monitor, control, and calculate all of the points and functions as listed in the Building Automation Schedule.

O. The system as installed shall have sufficient computer memory and application software for 100% point expansion above those points required and as listed in the Building Automation Schedule.

P. The Work includes the providing of all labor, materials, equipment, accessories, services and tests necessary to complete the place into satisfactory operation a complete system of automatic temperature controls as shown on the Drawings and hereinafter specified.

Q. The control system shall be of the electronic fully modulating type unless otherwise indicated, or as hereinafter specified. Control equipment shall be as manufactured by Andover, Siemens, Johnson Controls, Inc., Automated Logic Corporation, or Honeywell, Inc. All controls shall be the product of one manufacturer. The temperature control manufacturer shall be responsible for the quality and satisfactory operation of material provided even if not actually manufactured by him.

R. The control system shall include all necessary temperature sensors, damper motors, relays, sensors valves, etc., and all necessary equipment for a complete control system, regardless of whether or not specifically mentioned.

S. The control system shall include all control and interlock wiring. The control wiring shall include all wiring, including power wiring for sensors, controls, control devices, relays, freezestats, firestats and all other necessary equipment to provide a complete control system, regardless of whether or not specifically mentioned, unless otherwise shown on the electrical drawings, including electric relays and contactors required for control interlocking. Interlock wiring shall include interlocks between fan starters between pump starters between starters and remote condensing units, between pumps, chillers and cooling towers and wherever else called for in these specifications. Unless otherwise noted; all control circuits shall be 120 volts or less.

T. Provide nameplates on all devices, whether or not mounted on the face of local control panels. In occupied areas, nameplates shall be concealed beneath covers of room type instruments, to describe functions.

U. Contractor shall provide all source code, passwords, device addresses, BACNET set-up parameters and login information in hard copy and as a DVD as a condition for final payment.

1.3 GENERAL INSTRUCTIONS

A. The BMS/ATC systems as specified herein shall be provided in their entirety by the BMS/ATC Contractor. The BMS/ATC Contractor shall base his Bid on the systems as specified.

B. The general provision of the contract (Division 1 and sections 23 05 01, 23 05 02, and 23 05 03) apply to work specified in this section.

C. PRELIMINARY SUBMITTAL: Prospective BMS/ATC Contractors shall submit for review by the Owner's authorized representatives a preliminary written description of his proposed BMS/ATC systems, including block diagrams showing all major components and panels, printers and other processing devices and required cabling between each. Include environmental and space requirements for panels, CPU's and other major devices.

1. Include manufacturer's literature for each type of panel, controller or device that may be shown on the block Diagram.
2. Block Diagram shall show, schematically, the entire building system with all major components identified.
3. Include a points list for all input and output devices which shall be provided by the proposed systems.
4. Include information about proposed communications buss and data transmission.
5. Provide a written explanation of any characteristics, items of equipment or control intent, which differs from the requirements of this Division. Explain what, if any, alternative characteristics, items of equipment or control intent will be provided.
6. Alternate systems, characteristics, items of equipment or control intent, which do not comply with these specifications may be rejected if not acceptable to the Engineer. Any rejected alternate system, characteristics, items of equipment or control intent shall be replaced by the specified system, characteristics, items of equipment or control intent at no extra cost to the project.

1.4 QUALITY ASSURANCE

A. Only firms regularly engaged in manufacture and installation of this equipment with characteristics and capacities required, whose products have been in satisfactory use in similar service for not less than 10 years shall be acceptable.

B. The entire building automation system shall be installed by skilled electricians and mechanics, all of whom are properly trained and qualified for this work. All wiring shall be installed in accordance with the Project Electrical Specifications.

C. Supervision and checkout of the system shall be by factory-trained engineers and technicians directly employed by the automation Contractor.

D. Provide system produced and installed by the manufacturers, which are listed in Section "Approved Manufacturer's List".

E. Provide equipment which performance, under specified conditions, is certified by the manufacturer.

1.5 SCOPE

Extend the existing BMS to serve new equipment installed as part of this project. Provide all necessary hardware, devices, sensors, software, etc. as required to implement controls

indicated in the documents.

A. The proposal shall be based on an electronic or electronic system. Valve and damper actuators shall be electronic actuated – at BMS/ATC Contractor's option. Provide electronic sensors and transmitters with full DDC capabilities.

B. The engineering, installation, calibration, hardware, software programming and checkout necessary for complete and fully operational BMS/ATC systems, as specified hereafter, shall be provided under this division by the BMS/ATC Installer.

C. The BMS Contractor shall guarantee that the installed system is capable of maintaining the following comfort goals in conditioned areas served by the BMS.

1. Space Design Temperature +/- 1ºF.
2. Relative Humidity 50% +/- 5%.
3. The BMS Contractor is not responsible for improper installation by other Divisions, however the BMS Contractor is responsible for informing the Construction Manager and Engineer of any requirements of this specification or any installation problem which prevents these goals from being maintained.

D. The contractor shall be responsible for all power and control wiring for BMS equipment including BMS panels, actuators, dampers, controllers, control power transformers, relays, etc. work shall be sub-contracted to a licensed electrical contractor by the BMS contractor if the BMS contractor is not suitably licensed. All work shall be completed in accordance with the electrical specification sections of this specification .

1.6 ITEMS REQUIRED TO BE COORDINATED WITH OTHER DIVISIONS

A. Be responsible for coordinating the following:

1. Power requirements (voltage, amps, location) for all BMS equipment requiring power. See Section 23 05 01.

B. Installation and connection of all power wiring. Power wiring shall be defined as follows:

1. Wiring of power feeds through all disconnect starters and variable speed controllers to electric motors.
2. 120 VAC Emergency and 120V Normal power feeds to all BAS temperature control panels and equipment.
3. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by the BAS/ATC Contractor.

C. Note that 120V to 24V surge protected transformers for low voltage wiring by this Division shall be furnished, set in place and wired (from designated circuit in electrical panel) by this Division, and all low voltage control wiring shall be installed under this Division.

1.7 WORK BY OTHERS

A. The following work shall be provided under separate divisions of the specifications:

1. Installation of all line size and non-line size automatic valves and separable wells. However, these devices shall be furnished under this division.
2. Provision of all necessary piping connections, taps and direct-contact wells required for flow, pressure or temperature devices specified under other divisions.
3. Provision of manual balancing dampers as specified under other divisions of Divisions 21 through 23.
4. Installation of all automatic control dampers shall be by HVAC Contractor. All control dampers shall be furnished under this division.

1.8 AGENCY LISTINGS

A. UL 916 PAZX Energy Management Systems.

B. FCC-Part 15 Subparagraph J. Class A. Emissions requirements.

C. UL-864/UUKL Smoke Removal.

1.9 RELATED SECTIONS

A. 23 05 01 - Mechanical and Electrical Coordination.

B. 23 05 02 - Basic Mechanical Requirements.

C. 23 05 03 - Basic Mechanical Materials and Methods.

1.10 BMS/ATC CONTRACTOR

A. The BMS/ATC Contractor shall have a local office within a 50 mile radius of the job site, staffed with factory trained engineers fully capable of providing instruction, routine maintenance and 24-hour emergency maintenance service on all system components. The BMS/ATC Contractor shall have a ten year experience record in the design and installation of computerized building systems similar in scope and performance to that specified herein, and shall be prepared to provide evidence of this history prior to Contract Award should the Owner request it.

B. The BMS/ATC Contractor shall be prepared to make a personal presentation of his systems to the Owner or his designated representatives prior to award of Contract should the Owner request it.

C. The engineering, installation, calibration, hardware, software programming and checkout necessary for complete and fully operational BMS/ATC systems, shall be provided under this division by the BMS/ATC Installer.

D. Control components shall be mounted and wired by the BAS/ATC Contractor except as noted. Controllers may be mounted on terminal units at the factory.

1.11 SUBMITTALS AFTER CONTRACT AWARD

A. The following data/information shall be submitted for approval:

1. Complete sequence of operation.

2. Control system CAD generated drawings including all pertinent data to provide a functional operating system.
3. Valve, and damper schedules showing size, configuration, capacity and location of all equipment.
4. Data sheets for all hardware and software control components.
5. A description of the installation materials including conduit, wire, flex, etc.
6. Building Management System panel locations.
7. Schematic and flow diagrams indicating sensor and device locations.
8. A list of all points with summary counts, including alarms and trend.
9. Schematic and flow diagrams indicating sensor and device locations.
10. Trend Analysis and Optimization: Submit proposed sequence, timeline and proposed activities for each piece of equipment or system for the 2 year duration of the optimization scope of work.
11. Operating schedules.

B. The Controls Contractor shall provide submittal drawings for the entire control system for review and approval before work shall begin. Included in the submittal drawings shall be a diagram depicting the system architecture complete with a communications riser. Drawings shall include point-to-point wiring diagrams and must show all temperature controls, start-stop arrangement for each piece of equipment, equipment interlocks, wiring terminal numbers and any special connection information required for properly controlling the mechanical equipment. The submittal shall include a bill of material reference list as well as equipment sequences of operation.

C. Points list includes, for each physical or logical point, the name, description, display units, alarm limits, and definitions, along with the object description, object ID, and associated device ID. The list shall also indicate whether Trend Log or Schedule objects have been established for the point.

D. The submittals shall include a specification compliance analysis for review and approval before work shall begin. The compliance document shall address each paragraph of this specification by indicating COMPLY, EXCEED, or EXCEPTION. Do not indicate COMPLY unless the proposed system exactly meets the paragraph requirement. If EXCEED or EXCEPTION is indicated, then provide a clear and concise explanation of the variance from the specifications and the net effect this would have on the specified system performance.

E. Wiring diagrams shall include internal wiring of all electrical control devices.

F. Submit completed computer graphics for all the equipment and building floor plans and equipment prior to scheduled completion of the project for approval.

PART 2 – PRODUCTS

2.1 GENERAL

A. The Building Management System (BMS) shall provide an easy to use interface for monitoring and managing the building. The Building Management System shall provide the necessary Hardware, Software, and Network Communication abilities to provide Scheduling, Monitoring, Trending, Historical Storage, and Alarm Functions for the HVAC equipment and systems as described in this specification. Control capabilities shall include: Time of Day scheduling,

Direct Digital Control, Custom Control, Boolean Logic, Optimum Start/Stop, Duty Cycling, Electrical Demand Control, Temperature Control, After Hours Override, Reports and Logs, Trend Prints, Remote Communications, Alarm Logging, Run Time and Maintenance, and Expanded Informational Messages.

B. The Building Management system shall be designed to allow full Operator operation with a minimum of training. It shall have an on-screen "Help" Operator tutorial.

C. Specified application programs shall be engineered, programmed and pre-tested prior to site installation. This shall be verified by standard format programming worksheets or flow diagrams included with the submittals.

2.2 BUILDING MANAGEMENT SYSTEM

A. Each panel memory shall be protected for a minimum of 48 hours in the event of power failure. Internal clock shall continue to run during a power failure so that the system makes the appropriate adjustment to all connected points when power is restored.

B. When specified or indicated on the point list or where required by the sequence of operation, outputs shall have three position manual override switch (On/Off/Auto), a status light, and shall be selectable for either normally open or closed operation.

2.3 MANUFACTURERS

A. Acceptable Manufacturers Are:

1. Andover Controls – EMF
2. Andover Controls – Albireo - Anthony Nobile (732) 407-6082
3. Andover Controls – ACL
4. Johnson Controls as installed by local factory office.
5. Landis Staefa as installed by local factory office.
6. Siemens Controls as installed by local factory office.
7. Trane as installed by local factory office.

Any other manufacturer shall be considered a substitution and may submit for approval after the bid.

2.4 SYSTEM PERFORMANCE

A. The system shall consist of Operator Workstation, Building Management Panels, and Application Specific Controllers. All elements of the system shall be designed for standalone operation. Control shall always occur at the lowest level of the system. Communication between the building management panels and workstations shall be over a high speed communications buss. All nodes on this LAN shall be peers. The operator shall not have to know the panel identifier or location to view or control an object. Application Specific Controllers shall be constantly scanned by the building management panels to update point information and alarm information.

2.5 SYSTEM APPLICATION CONTROLLER SOFTWARE

A. System Security: User access shall be secured using individual security passwords and user names.

B. Passwords shall restrict the user to only the object, applications and system functions as assigned by the system manager.

C. Provide the owner with the highest level of access to the software and CDs with the current versions of all software provided under this contract.

2.6 SYSTEM SOFTWARE

A. Furnish the following applications for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

1. Scheduling: Provide the capability to schedule each object or group of objects in the system. Each scheduler shall consist of the following:
   a. Weekly Schedule: Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, stop, optimal start, optimal stop, and night economizer. Each scheduler may consist of up to 10 events. When a group of objects are scheduled together, provide the capability to adjust the start and stop times for each number.
   b. Exception Schedules: Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to one year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
2. Optimal Start/Stop: The scheduling application outlined above shall support an optimal start/stop algorithm. This shall calculate the thermal characteristics of a zone and start the equipment prior to occupancy to achieve the desired space temperature at the specified occupancy time. Provide an early start limit in minutes to prevent the system from starting too early.
3. System Coordination: Provide a standard application for the proper coordination of equipment.
4. Alarm Reporting.
5. Trending.
6. Diagnostics.
7. Power Fail Recovery.
8. Reports and Logs.

2.7 NETWORK CONTROLLERS

A. General. Provide an adequate number of Building Management Panels to provide the performance specified above. Each of these panels shall meet the following requirements.

1. The Building Automation System shall be composed of one or more independent stand-alone, microprocessor based Network Controllers to manage the global strategies describes in Application software section.
2. The Master Controller shall have substantial memory to support its operating system, database, and programming requirements.

3. The multi-tasking operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
4. Data shall automatically be shared between Master Controllers when they are networked together.
5. The database and custom programming routines of remote Network Controllers shall be editable from a single operator station.
6. The Master Controller shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:
   a. Assume a predetermined failure mode.
   b. Emit an alarm.
   c. Display card failure identification.

B. Communications. Each Master Controller and Operator Workstation shall communicate using 10/100/1000 Ethernet (IEEE802.3). This LAN shall be self configuring and shall automatically reconfigure as nodes are added or removed.

1. Hard Wired Connections. Provide a twisted pair copper (CAT.5E or higher) cable between all nodes on the system LAN. Provide all necessary network switches to complete the network.

C. All controllers shall allow communication over open protocol such as LonTalk or BACNET. Open protocol; shall be appropriate to the signal being transmitted and shall selected to best communicate with the domains open protocol for systems that have been previously installed at the facility.

D. Serviceability. The Network Controller should be designed in a modular fashion so that the enclosure may be roughed in prior to the installation of the electronics. Provide diagnostic LEDs for power, communications, and alarms. The controller shall have provisions for expansion and future controller architecture. All wiring connections shall be made to field serviceable terminal strips or to a termination card connected by a ribbon cable.

E. Memory. The Network Controller shall maintain all BIOS and programming information in EEPROM. The system BIOS shall be easily upgradable for the PC workstation without the need for going out to the panel. System manufacturer shall provide current version software and firmware at the end of the warranty period.

F. Controller software must be capable of detecting hardware and software failures and forcing all outputs to a predetermined state, consistent with the failure mode requirements defined on the drawings. In this state it shall issue an alarm.

G. Volatile memory is required to be backed up in the event of power loss. Software stored in non-volatile memory will not have to be downloaded from the central server after an interruption of power occurs.

H. Controllers used for time-scheduled operations must be equipped with a battery backed internal real-time clock function to provide a time base for implementing time-dependent programs. Provision shall be made for the routine updating of the controllers' clocks via a time master.

I. Resumption of power after an outage shall cause the controllers to automatically restart and establish communications as needed by their applications. Controller shutdown based on a

self-diagnosed failure in the power supply, hardware, or software must set each piece of controlled equipment to a predetermined failure mode.

J. Controllers shall be powered from the most reliable source that powers any of the systems it serves. In the situation where a controller will be required to continuously collect data to be transmitted to a workstation, or where it monitors critical recovery information such as the presence of emergency power, it may be necessary to provide a UPS for the controller as well as any critical sensors. Where panels are provided with a different power source as the equipment (such as when the panel is on a UPS), the panel shall be provided with a means of monitoring the power source to the controlled equipment. This can be a dedicated power monitor or a value coming from transfer switch contacts.

2.8 APPLICATION SPECIFIC CONTROLLERS

A. Application Specific Controllers shall be stand-alone, microprocessor based Direct Digital Controllers with sufficient EEPROM memory to handle its operating system, database and programming requirements.

The controllers shall be clearly labeled as to controller type, where it is to be installed, and software address (if applicable). The controller shall be fully tested upon installation to ensure that it is properly matched to the equipment it is controlling.

B. The controller shall communicate with other devices on the communication network and be fully integrated with the other system components.

C. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at –40°F to 155°F.
2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32°F to 120°F.

D. Terminal Unit Controllers

1. The VAV terminal units shall be individually controlled by a dedicated DDC VAV controller. The DDC VAV controller, damper motor, transducer and transformer (if required) shall be supplied by the BAS contractor.
   a. To assure proper operation and control, the BAS contractor as part of this bid, shall recalibrate the transducers six (6) months after acceptance of the BMS system to correct any deviations as a result of transducer drift.
   b. Submit a copy of the recalibration report to the Engineer, Mechanical Contractor, Test, Adjust and Balance Contractor and Owner.
   c. Setpoint Control: The BMS shall edit the zone space temperature setpoint of each VAV box. The zone temperature setpoint shall be operator adjustable. Individual zone setpoint and control logic shall reside at the zone level, and not be dependent upon the BMS for control. In the event of communication loss, the box will continue to control to current setpoints.
   d. Manual/Automatic Setpoint Control: Where indicated in the contract documents, provide a combination zone temperature sensor/temperature sensor (S/T) with master control via the Operator’s Work Station. In automatic mode, the S/T shall

operate only as a room sensor. In Manual mode, the space occupant shall have the capability to raise or lower space setpoint within limits established by BMS.

e. Override Button: Where indicated on the contract documents, the VAV box shall be capable of being placed in the “occupied” mode. Operation of the over-ride shall energize the associated air handler.

f. Override Cancel Button: The VAV box shall be capable of being placed back into the “occupied” mode by the zone occupant for a preset time period (adj.).
   1) The following areas shall have manual temperature re-set capability and unoccupied over-ride button:
      a) All office areas.
      b) All other areas shall have temperature sensing capability only.

g. Cooling Valve Control: The BMS shall control the cooling air valve to a fully open, fully close, maximum CFM, or minimum CFM position based on operator commands. The operator shall also have the capability to adjust the maximum and minimum airflow limits of the air valve through the BMS.

h. Operating Mode: The BMS shall place the box in either the occupied or unoccupied mode based on an operator adjustable time schedule. Separate heating and cooling setpoints shall be enterable for each mode through the BMS. Other modes available for special applications shall include full open, full closed, maximum flow, heating flow, minimum flow, [and “Game Day/VAV” occupied minimum flow].

i. Occupied status shall be further divided into Game Day/Office/or Player Occupied schedule as appropriate. Certain public or player occupied areas shall have a higher “minimum occupied” setting for Game Day or Player Occupied time periods.

j. Control Offset: The BMS shall be capable of offsetting the cooling or heating setpoints of one or more groups of boxes by an operator adjustable amount. This capacity will allow for automatic zone setpoint changes based on system requirements, such as demand limiting.

k. Automatic Recalibration: The system shall automatically recalibrate its air flow sensing and air valve position measurement system at system startup and on a schedule basis.

l. Portable interface terminal: The VAV box shall have a communications port on the space sensor for use with a hand held portable operator’s terminal. This portable terminal shall give the operator the capability to interrogate and edit DDC/VAV box parameters. Portable interface terminal shall also have the capability to interrogate and edit DDC/VAV box parameters from a central controller.

m. Terminal Unit Status Reports: For each terminal unit, the BMS shall provide an operating status summary of all unit sensed values (zone temperature, CFM, etc.), setpoint and modes.

n. Terminal Unit Group Report: For each group of VAV terminal units, the BMS shall report the group mode, heating and cooling airflow, average zone temperature, minimum zone temperature, and maximum zone temperature. The report shall also display for each terminal unit in the group, the present temperature control setpoints and the current zone temperature.

2. Terminal Box Diagnostics:
   a. If zone temperature sensor input fails above its high range, unit shall control at its maximum CFM setpoint. If sensor input fails below its low range, units shall control to its minimum CFM setpoint.
   b. In both cases, all heat outputs shall be disabled. A diagnostic message shall be displayed upon operator inquiry.

c. If flow measuring system fails, unit shall automatically convert to a pressure dependent, damper position based algorithm. Diagnostic message shall be displayed upon operator inquiry.
d. If zone temperature setpoint potentiometer on zone sensor fails, unit shall automatically control to programmed occupied setpoints. Diagnostic message shall be displayed upon operator inquiry.
e. If communications are not lost, controller shall continue to operate in current mode of operation. All setpoints shall be retained in nonvolatile memory. If communications are not restored within 15 minutes, unit shall automatically initiate a reset-recalibrate.

E. Controller software must be capable of detecting hardware and software failures and forcing all outputs to a predetermined state, consistent with the failure mode requirements defined on the drawings. In this state it shall issue an alarm.

F. Volatile memory is required to be backed up in the event of power loss. Software stored in non-volatile memory will not have to be downloaded from the central server after an interruption of power occurs.

G. Controllers used for time-scheduled operations must be equipped with a battery backed internal real-time clock function to provide a time base for implementing time-dependent programs. Provision shall be made for the routine updating of the controllers' clocks via a time master.

H. Resumption of power after an outage shall cause the controllers to automatically restart and establish communications as needed by their applications. Controller shutdown based on a self-diagnosed failure in the power supply, hardware, or software must set each piece of controlled equipment to a predetermined failure mode.

I. Controllers shall be powered from the most reliable source that powers any of the systems it serves. In the situation where a controller will be required to continuously collect data to be transmitted to a workstation, or where it monitors critical recovery information such as the presence of emergency power, it may be necessary to provide a UPS for the controller as well as any critical sensors. Where panels are provided with a different power source as the equipment (such as when the panel is on a UPS), the panel shall be provided with a means of monitoring the power source to the controlled equipment. This can be a dedicated power monitor or a value coming from transfer switch contacts.

2.9 CUSTOM APPLICATION CONTROLLERS

A. The Custom Application Controllers shall provide stand-alone control and require no additional system components for complete operation. It shall have sufficient EEPROM memory to support its operation system, database, and programming requirements. Custom application controllers shall meet the requirements of 2.06 Master Control Panels except they shall reside on a communications network operating at a minimum of 38,400 KBPS.

B. All programming required for operation shall be memory resident and shall be retained in permanent memory.

C. The Custom Application Controller shall be configured such that the Portable Operators Terminal can be plugged directly into it or within sight for programming, editing, and other operator functions. Custom application controllers shall also be programmable from the

operator workstation.

D. Controller hardware shall be suitable for the anticipated ambient conditions.

E. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures and shall be rated for operation at –40°F to 155°F.

F. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32°F to 120°F.

G. Controller software must be capable of detecting hardware and software failures and forcing all outputs to a predetermined state, consistent with the failure mode requirements defined on the drawings. In this state it shall issue an alarm.

H. Volatile memory is required to be backed up in the event of power loss. Software stored in non-volatile memory will not have to be downloaded from the central server after an interruption of power occurs.

I. Controllers used for time-scheduled operations must be equipped with a battery backed internal real-time clock function to provide a time base for implementing time-dependent programs. Provision shall be made for the routine updating of the controllers' clocks via a time master.

J. Resumption of power after an outage shall cause the controllers to automatically restart and establish communications as needed by their applications. Controller shutdown based on a self-diagnosed failure in the power supply, hardware, or software must set each piece of controlled equipment to a predetermined failure mode.

K. Controllers shall be powered from the most reliable source that powers any of the systems it serves. In the situation where a controller will be required to continuously collect data to be transmitted to a workstation, or where it monitors critical recovery information such as the presence of emergency power, it may be necessary to provide a UPS for the controller as well as any critical sensors. Where panels are provided with a different power source as the equipment (such as when the panel is on a UPS), the panel shall be provided with a means of monitoring the power source to the controlled equipment. This can be a dedicated power monitor or a value coming from transfer switch contacts

2.10 INPUT/OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into the system through Master Control Panel, Custom Application, or Application Specific Controllers. Any critical points requiring immediate reaction shall be tied directly in to the controller hosting the control software algorithm for the critical function.

B. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a sufficient wetting current to be compatible with commonly available control devices.

All status points shown on the point list shall be positive proof differential pressure or current sensing binary switches.

C. Analog inputs shall allow the monitoring of low voltage, current, or resistance signals and shall have a minimum resolution of 0.1% of the sensing range. Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

D. Binary outputs shall provide a continuous low voltage signal for on/off control of remote devices. Where specified in the sequence of operations or indicated on the points list, binary outputs shall have 3-position (on/off/auto) override switches, status lights, and shall be selectable for either normally open or normally closed position.

E. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC, 0 to 20 VDC or a 4 to 20 milliampere signal as required to provide proper control of the output device. Systems that utilize a pulse width modulating output (PWM) shall include a position feedback AI for each output.

F. System architecture shall allow for point expansion in one of the following ways:

1. The addition of input/output cards to an existing System Application Controller.
2. An additional panel and/or controller may be used to expand point capacity.
3. Ten (10) percent expansion capacity for all point types in all DDC panels.

2.11 IDENTIFICATION

A. Engraved Labels

1. Material: Melamine plastic laminate.
2. Thickness: 1/16”.
3. Color
   a. Surface: White.
   b. Core: Black (letter color).
4. Fastenings: Any of the following:
   a. Screws.
   b. Rivets.
   c. Permanent adhesive.
5. Lettering: Coordinate with shop drawings.

2.12 DUCT SMOKE DETECTORS

A. Duct smoke detectors shall be provided and wired in accordance with manufacturer’s requirements.

2.13 BMS/ATC CONTROL WIRING

A. General: 18 AWG Twisted pair cable shield wire shall be provided if required by system manufacturer.

B. Provide for all input and all analog output wiring.

C. Tinned copper conductors.

D. Do not run input/output wires together in the same conduit or wire bundle with 120V power wiring.

E. Pneumatic or sensor tubing shall not be installed in conduit with any wiring conductors.

F. All control wiring shall be run in metal conduit as follows:

1. EMT in Mechanical/Electrical Rooms.
2. Rigid at exterior.
3. Plenum rated for concealed spaces/hung ceiling.

G. Unless specifically required otherwise by the BACS equipment manufacturer, all I/O wiring shall be twisted shielded cable. For communications, the BACS equipment manufacturer's installation guidelines and recommendations shall apply.

H. All control wiring in mechanical equipment rooms or other spaces in which it is readily accessible shall be installed in electrical metal tubing (EMT) with compression fittings.

I. All control wiring run in interstitial spaces shall either be run in EMT or a cable tray or raceway.

J. All control wiring installed outdoors or any area subject to moisture shall be installed per code.

K. All control wiring installed in vertical chases shall be installed in EMT.

L. All control wiring above non-accessible ceilings shall be installed in EMT.

M. All control wiring installed above accessible ceiling spaces which are not laboratories or AHU's shall be plenum type, not installed in conduit, but neatly run with generous use of rings or ties.

N. Wire shall be unspliced from the controller to the sensor or device.

O. Control wiring shall not be routed in the same raceway as power wiring.

P. For sensors with twisted shielded pair cable, the shield shall be grounded at the panel and taped back at the sensor.

Q. Control wiring shall be color coded and labeled at all points of termination.

R. Remove and properly dispose of all abandoned control wiring, conduit, tubing, boxes, enclosures, components, and other controls-related work.

2.14 DAMPERS

A. The Building Automation System supplier shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment.

B. Dampers shall be low leakage air foil as specified in the sequence of operation or in the equipment specifications and schedules. All proportional dampers shall be opposed blade type, except mixing dampers shall be parallel type. Two position dampers may be opposed or parallel blade type.

C. Damper frames and blades shall be galvanized steel and a minimum of 16 gauge. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of –50°F to 250ºF.

D. Blades: 14-gauge,or 16-gauge air foil shaped, double, galvanized steel or extruded aluminum.

E. Bearings: Nylon or oil impregnated.

F. Axles: Welded, hexagonal or pin lock, or with other approved method to prevent blade rotating on axle.

G. Hardware: Zinc plated steel or aluminum.

H. Standard Low Leakage Dampers:

1. Standard low leakage dampers shall be provided to conserve energy. Dampers shall be equipped with neoprene edge seals and compressible metal jamb seals. Leakage shall not exceed 10 CFM/Sq. Ft. at 4” W.G. differential and 3 CFM/Sq. Ft. at 1” W.G. differential.
2. Standard Low Leakage dampers shall be Ruskin, Model CD36 or equivalent.

I. Provide low leakage dampers in the following locations:

1. Outside air dampers.
2. Motorized backdraft dampers.
3. Motorized intake dampers.

J. Dampers shall be applicable for the rated pressure and velocity service. Damper structural rating shall exceed extreme anticipated conditions like fan deadhead.

K. Modulating dampers shall be carefully selected to control in a smooth and stable fashion across the range of anticipated conditions. Except where size dictates a single blade, dampers shall always be opposed blade. When a large section of damper is to be connected to a single jackshaft, size limitations shall be followed. This will prevent excessive damper area or, more importantly, length from being connected to a single jackshaft. Typically, the manufacturer’s recommendation shall be sufficient for specifying a limit to the size of a damper bank that may have field fabricated jackshaft connections.

L. Whenever possible, dampers shall have external crankshafts to allow the connection of the damper actuator outside of the air stream. This will allow for easier access to the actuators for maintenance.

M. Outside air control dampers shall be low leakage dampers with damper seals.

N. Output to modulating control dampers shall be analog.

O. Acceptable Manufacturers:

1. Ruskin
2. Greenheck
3. Nailor

2.15 CONTROL VALVES

A. Provide control valves of the type, body material and pressure class as determined by manufacturer, based on operating requirements and maximum pressure and temperature in the piping system.

B. Equip control valves with actuators of proper close-off rating.

C. Modulating control valves shall have equal percentage or linear flow characteristics.

D. Valve bodies shall be 2-way normally open or closed or as required. Valve bodies 2" and smaller shall be bronze, screwed type and 2½" and larger shall be iron, flanged and rated at 240°F 125 psig except where otherwise noted.

E. Valves shall have stainless steel stems and allow for servicing including packing, stem, and disk replacement, or offer a 5 year warranty on parts and labor.

F. Size valves for 50% coil pressure drop (minimum 3', maximum 12' pressure drop).

G. Two-position, two-way control valves shall have quick opening characteristics.

H. All steam control valves shall be single seated. No single valve shall be larger than 2-1/2". Wherever the flow rate is such as to require a valve larger than 2-1/2", then multiple valves in parallel shall be used, with one no larger than 2-1/2". The valves shall operate sequentially. Trim shall be stainless steel for inlet pressures above 15 psig steam. Actuators shall be pneumatic.

I. Valves shall be applicable for the rated pressure and temperature service. Close off pressures must be determined in concert with the actuators and valves shall be provided to close off against extreme anticipated conditions. Valves shall be selected such that they are not, as a practice, "oversized."

J. Modulating valves shall be carefully selected to control in a smooth and stable fashion across the range of anticipated conditions. "Split ranging" of heating and cooling valves controlled by the BACS is not acceptable. A separate output from the BACS shall be provided for all control valves. General guidelines are indicated below. When the selection criteria indicated below are not met, flow characteristic analyses shall be submitted to demonstrate reasonable correlation between stroke and flow. Valves with a CV greater than 30 may be pneumatically actuated, but should only be used if a cost benefit analysis shows they are preferred. Actuator positioning requirements are as follows for each type, if used:

1. Electric Input: 4-20 mA or 0-10 VDC.
2. Electrically piloted valves shall have a pneumatic actuator with positioner.
3. Pilot positioners shall be required as necessary to keep the valve closed under the maximum differential pressure.

K. Pressure independent control valves can be utilized, but are not preferred. If used, they shall be two-way pressure independent control valves such that balancing of the valves and associated branch piping shall not be required. Requirements shall be as follows:

1. Absolute flow accuracy:

   a. +/- 5% due to system pressure fluctuations across the valve in the selected operating range.
   b. +/- 5% due to manufacturing tolerances.

2. The control signal shall be modulating.
3. The valves shall accurately control the flow from 0% to 100% of full rated flow.
4. A minimum of 2 PSI shall be required to operate the valve pressure independently.
5. The valves shall require no maintenance and shall not include replaceable cartridges.
6. The valves shall be available with optional pressure/temperature ports to allow for flow verification.

2.16 VALVE ACTUATORS: (ELECTRIC)

A. Valve actuators shall be electronic low voltage (24VAC), and properly selected for the valve body and service. Belimo or equivalent.

B. Actuators shall be fully proportioning (if modulating) and be spring return for normally open or normally closed operation as called out in the sequence of operations.

C. Provide a handwheel or manual positioner mounted adjacent to valve to allow manual positioning of valve in the absence of power.

D. Tri-state floating control non-spring return actuators are acceptable for terminal reheat applications for sizes less than one inch.

E. Actuators that rely on heating a medium are not acceptable.

2.17 BUTTERFLY VALVES

A. Butterfly valves used for automatic control shall be lug type rated for 125 psi non-shock water service to 180°F. Valve body shall be ductile iron with B-Nitrite (BUNA N) or EPDM molded seat and seals.

B. Disc material shall be cast bronze of aluminum-bronze with ASTM A-492 Type 416SS stainless steel stem and fittings.

C. Valves shall be tight close off suitable for end of the line service.

D. Butterfly valves used for two position control shall be line size. Valves used for modulating control shall be sized for a minimum 5 psig differential pressure at full flow. Butterfly valves shall not be used for modulating control without specific approval from the engineer.

E. Three way valve mixing or diverting configurations shall have factory provided linkage kits specifically manufactured for the piping arrangement and actuator used. Keystone or approved equivalent.

2.18 TEMPERATURE SENSORS

A. Temperature sensors shall be Resistance Temperature Detector (RTD) or Thermistor as dictated by the requirements of this specification.

B. Duct sensors shall be rigid or averaging as specified in the sequence of operations. Averaging sensors shall be a minimum of 5 feet in length.

C. Immersion sensors shall be provided with a separable stainless steel or brass well to match pipe material.

D. Space sensors shall be equipped with setpoint adjustment and/or override switch as specified on the plans or in the sequence of operations. Space sensor shall have a portable service tool jack.

E. Accuracies shall be +/-1°F for standard applications. Where high accuracy is required, accuracies shall be +/- .2°F.

F. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacturers recommendation and looped and fastened at a minimum of every 36 inches.

G. Sunshields shall be provided for outside air sensors.

H. Sensor Resolution: When matched with A/D converter of the controller, sensor range shall provide a resolution of no less than 0.4 °F (unless noted otherwise).

I. Room Temperature Sensor: These shall be an element contained within a ventilated cover, suitable for wall mounting. Provide an insulated base.

1. Sensing element: RTD or thermistor, +/- 0.8°F accuracy at calibration point.
2. Setpoint Adjustment: Provide where indicated. Public spaces shall not have setpoint adjustment. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BACS.
3. Occupancy Override: Provide a button on the room sensor enclosure where indicated, generally in office spaces that do not have occupancy sensors. Public spaces shall not have occupancy override. This shall be a momentary contact closure.
4. Display: Alphanumeric.
5. Sensors shall be provided with communication jack and appropriate cabling for connection to the BACS.

J. Single Point Duct Temperature Sensor: These shall consist of a sensing element, junction box for wiring connections, and a gasket to prevent air leakage or vibration noise. The sensor probe shall be stainless steel.

1. Sensing element: RTD or thermistor, +/- 0.5°F accuracy at calibration point.

K. Averaging Duct Temperature Sensor: These shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one foot of sensing element for each, two square feet of coil/duct face area.

1. Sensing element: RTD or thermistor, +/- 0.5°F accuracy at calibration point.

L. Liquid Immersion Temperature Sensor: These shall include brass or stainless steel thermowell, sensor and connection head for wiring connections.

1. Sensing element: RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.
2. Temperature Range: As required for resolution of 0.3°F.
3. Insertion Length: Sized to extend through entire length of thermowell bore, taking into account all required couplings and transitions.

M. Outside Air Temperature Sensor: These shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. On major/critical systems, one outside air temperature sensor shall be provided for each system; and one sensor shall be provided per mechanical room, or building-level controller. Generally, these shall be located on a north wall of the building and installed with stand-offs. On 100% outside air systems, locate the sensor in the outside air plenum.

1. Sensing element: RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.

2.19 HUMIDITY SENSORS

A. Humidity sensors shall be capacitance or bulk polymer resistance type.

B. Duct and room sensors shall have a sensing range of 20 to 80% with accuracy of +/-3% R.H. Duct sensors shall be provided with a sampling chamber.

C. Outdoor air humidity sensors shall have a sensing range of 20 to 95% RH. They shall be suitable for ambient conditions of –40°F to 170°F.

D. Units shall be suitable for duct, wall (room), or outdoor mounting. Sensors shall be two-wire transmitters utilizing bulk polymer resistance change or thin film capacitance change. Units shall produce linear continuous output of 4-20 mA for % RH. Sensors shall have the following minimum performance and application criteria:

1. Input Range: 0 to 100% RH.
2. Accuracy (% RH): +/- 2% (when used for enthalpy calculation, dew point calculation, or humidifier control); or +/- 3% (when used for monitoring) between 20-90% RH at 77°F, including hysteresis, linearity, and repeatability.
3. Operating Range: As required by the application.
4. Long Term Stability: Less than 1% drift per year.
5. Acceptable Manufacturers:

    a. Vaisala
    b. Mamac
    c. Veris Industries

2.20 DIFFERENTIAL PRESSURE & CURRENT SWITCHES

A. Differential Pressure Switches shall be furnished as indicated for status purposes in air and water applications. Provide single pole double throw switch with fully adjustable differential pressure settings.

B. Sensing range shall be suitable for the application with accuracy of +/-2% of range and repeatability of +/-.5 % of range. Sensor shall be capable of withstanding up to 150% of rated pressure without damage.

C. Current switches shall be provided for status indications on variable air flow fans and variable pump speed applications. These switches shall be capable of installation and replacement without removing power wiring.

2.21 STATIC PRESSURE SENSORS

A. Static pressure sensors shall be differential pressure type. The sensor range shall be closely matched to the system static pressure, - .5 to .5 inches, -1 to 1 inches, 0 to 2.5 inches.

B. Sensor accuracy shall be plus or minus 5% of the sensing range, and repeatability of 2% of sensor range.

2.22 FREEZE PROTECTION DUCTSTATS

A. An electric freeze protection ductstat with 20 feet low temperature sensing capillary, and with manual reset, shall be located across the entering face of each cooling coil or bank of coils in the air conditioning unit or in the discharge of each heating coil in the heating and ventilating units, which shall on a fall in temperature below 35˚F., shut down its respective supply fan and close the outdoor air damper. Case of instrument shall be located outside of supply unit, within 10 feet of supply fan motor.

B. For systems with return air fans, on fan shut down, the return fan shall continue running or shall start, if not running.

2.23 PRESSURE SENSORS

A. Differential air pressure, static pressure and velocity pressure sensors shall be furnished by Modus, Air Monitor or equivalent.

B. Liquid, water or steam pressure sensing shall be furnished by Rosemount, Robinson Halpern or equivalent.

C. Pressure switches shall be furnished by United Electric, Dwyer or equivalent.

D. Air Differential Pressure Sensors

1. General: Pressure transducers shall be either diaphragm or strain gauge types.
2. Applications: Duct static pressure, filter DP, fan DP, air flow VP, etc.
3. Provide the smallest range feasible for the application. Provide zero and span adjustments.
4. Accuracy: Plus or minus 1% of full scale for static and 0.25% for air velocity.

5. Acceptable Manufacturers:

   a. Filter DP: Dwyer
   b. General and Static Pressure: Mamac, Setra, Veris Industries
   c. Air Flow: Air Monitor, Paragon

E. Air Differential Pressure Switches:

1. Cleveland Controls, Inc., products shall be used. The switches shall be installed in accordance with the manufacturer's installation instructions. All switches shall be mounted in accessible and, to the extent possible, vibration-free locations (i.e., not on duct work).

2.24 FLOW SENSORS

A. Differential pressure flow meters shall be furnished by Annubar or equivalent.

B. Vortex flow meters shall be furnished by EMCO or equivalent.

C. Flow sensors shall be carefully placed to ensure flow profiles that are required for accurate flow sensing. Designs shall specifically indicate the location of the sensors and indicate the length of unobstructed duct or pipe upstream and downstream from the sensor.

D. Water flow sensors shall meet the requirements necessary for use for test and balance duty as defined in the BACS specifications.

2.25 DIGITAL SENSORS

A. All digital inputs will be provided by dry contacts. The contacts will be wired normally open or normally closed as required.

B. Motor status (pumps, fans, etc.) by current sensing switch shall use Neilsen-Kuljian current-operated switch.

C. Pump flow status by differential water pressure shall use Penn P74 or equivalent.

D. Fan status by differential pressure shall be Dwyer or equivalent.

2.26 POWER SENSORS (CURRENT, KW, KWH)

A. Chiller amps shall be sensed by current transducers. The range of operation shall be from zero to a value not more than 50% of FLA. Use Ohio Semitronics CT-E series or equivalent.

B. Utility metered or submetered KWH or KW shall be sensed by a pulse producing transducer.

C. Current Sensors

1. Application: Status indication on constant speed motors.
2. Sensor shall indicate loss of status when current falls below an adjustable trip point.
3. CS shall include LED indication of status.

4. Acceptable Manufacturer: Veris Industries.

D. Current Switches (CS) for Constant Speed Motors:

1. CS shall be provided for status indication of constant speed motors.
2. Switch shall indicate loss of status when current falls below an adjustable trip point.
3. CS shall include LED indication of status.
4. Acceptable Manufacturer: Veris Industries (H708/ H908 series).

E. Current Switches for Variable Speed Motors:

1. Typically, status indication that indicates VSD or bypass operation shall be derived from contacts on the VSD. The VSD must be specified to include this option.
2. Otherwise, a current switch shall be provided for status indication. The switch shall be microprocessor based and suitable for use on a VSD.
3. Self-adjusting trip setpoint.
4. Factory programmed to detect belt loss undercurrent conditions.
5. CS shall include LED indication of status.
6. Acceptable Manufacturer: Hawkeye.

2.27 KW/KWH TRANSDUCER

A. The meter shall be capable of measuring true power demand (kW) and consumption (kWH). Output to BMS shall be via BACNET interface card.

B. The meter shall be capable of providing a field selectable pulse rate output of 1, 0.5, 0.1, or 0.05 pulses per (kWH).

C. The transducer shall receive its current inputs from safe current transformers that provide a 0-10 V output proportional to the primary current flowing in the sensed load.

D. The current transformers shall be accurate to +/- 0.5% from 1% to 100% of the rated current.

E. The voltage range shall be field selectable from 120 to 600 VAC.

F. The meter shall be accurate to +/-0.5% of the reading over a -15˚ to 40˚ C range.

G. The meter shall detect phase loss, or a low voltage situation, and provide an N.C., optically isolated FET (100 ma @ 24 VAC/DC) alarm output.

H. The transducer shall have an adjustable low voltage threshold trip point from 75-95% of the rated power of the monitored load.

I. The meter shall be mounted inside a Nema 1 enclosure.

J. The meter shall have an LCD meter mounted in the Nema 1 enclosure to display demand (kW) and consumption (kWH).

K. The meter shall be Veris Industries series H8100. Exact model number and accessories shall be matched to the characteristics of the system being metered.

2.28 CARBON DIOXIDE SENSOR

A. Carbon Dioxide Sensor shall be Kele & Associates Model BA/AQS, 0 to 100% measuring range, 4 to 20 mA analog output.

B. Provide CO_2 sensor for all system specified, in all rooms or zones required to be measured or duct mounted for systems specified.

C. Application: Demand controlled ventilation of high density occupancy spaces, such as auditoriums, classrooms, lecture rooms, and conference rooms.

D. Acceptable Manufacturer: Vaisala

2.29 OCCUPANCY SENSORS

A. Single mode infrared sensors, with a minimum of two sensors per laboratory area, shall be used to establish occupancy/unoccupancy intervals. Schemes that utilize Time-of-Day (TOD), light switches and/or manual switches to establish lab occupancy shall be avoided. An unoccupied laboratory will be defined as having no people present in the room for a specified period of time (30 min. adjustable).

B. Occupancy sensors used in labs, classrooms, offices, and comparable spaces shall be Watt Stopper Model # CI-24 ceiling-mounted, 24VAC, passive infrared occupancy sensors. No substitutions considered.

C. Occupancy sensors used in auditoriums and comparable spaces shall be Watt Stopper Model # DT-200 wall-mounted, 24VAC, dual technology (passive infrared and ultrasonic) occupancy sensors. No substitutions considered.

D. Install no less than two occupancy sensors per space in laboratory spaces.

E. Occupancy sensors shall be installed in quantities such that unobstructed coverage of the entire space is provided.

2.30 DEWPOINT SENSORS

A. Units shall be suitable for duct, wall (room) or outdoor mounting with digital display. Sensors shall be two-wire transmitters utilizing bulk polymer resistance change or thin film capacitance change. Units shall produce linear continuous output of 4-20 mA for dew point temperature (°F). Sensors shall have the following minimum performance and application criteria:

1. Accuracy: +/- 1.8°F.
2. Sensor Operating Range: As required by the application.
3. Long Term Stability: Less than 1% drift per year.

B. Acceptable Manufacturers:

1. Vaisala only.

2.31 AIRFLOW SENSORS

A. Flow sensors shall be carefully placed to ensure flow profiles that are required for accurate flow sensing. Designs shall specifically indicate the location of the sensors and indicate the length of unobstructed duct or pipe upstream and downstream from the sensor.

B. Air Handling Unit and Duct Airflow Monitoring: A pitot-tube averaging grid of a material compatible with the environment is to be used. The use of fan inlet grids are preferable where possible to measure fan flow. Fan inlet grids shall be provided by the fan vendor and shall not block or affect fan efficiency. The transducer shall have the following specifications:

1. Accuracy: +/- 0.25%.
2. Stability: +/- 0.5% of full scale per year or less.
3. Auto-zero capability by venting ports to atmosphere.
4. Acceptable Manufacturers: Air Monitor, Paragon.

2.32 CONDENSATE SENSORS

A. Application: Moisture sensing on chilled water supply systems to terminal chilled beam devices.

B. Acceptable Manufacturers and Model Numbers:

1. Siemens QXA 2000
2. Sauter EGH 102
3. Honeywell H7018A1003

2.33 CONTROL VALVES

A. Valves shall be applicable for the rated pressure and temperature service. Close off pressures must be determined in concert with the actuators and valves shall be provided to close off against extreme anticipated conditions.

B. Modulating valves shall be carefully selected to control in a smooth and stable fashion across the range of anticipated conditions. “Split ranging” of heating and cooling valves controlled by the BACS is not acceptable. A separate output from the BACS shall be provided for all control valves. General guidelines are indicated below. When the selection criteria indicated below are not met, flow characteristic analyses shall be submitted to demonstrate reasonable correlation between stroke and flow. Actuator positioning requirements are as follows for each type, if used:

1. Electric Input: 4-20 mA or 0-10 VDC
2. Electrically piloted valves shall have a pneumatic actuator with positioner

C. The BMS output to modulating valves shall be analog. In addition:

1. Terminal reheat valves shall be proportional
2. Fan coils and similar terminal device valves shall be proportional
3. Radiation valves shall be two-position or proportional
4. Unit heaters shall be two-position line voltage thermostats.

D. Two-way Pressure Independent Control Valves: Pressure independent control valves can be utilized, but are not required. If used, they shall be two-way pressure independent control valves

such that balancing of the valves and associated branch piping shall not be required. In addition:

1. The absolute flow accuracy through the valve shall be:
   a. +/- 5% due to system pressure fluctuations across the valve in the selected operating range
   b. +/- 5% due to manufacturing tolerances
2. The control signal shall be modulating as described above
3. The valves shall accurately control the flow from 0% to 100% full rated flow
4. A minimum of 2 PSI shall be required to operate the valve pressure independently
5. The valves shall require no maintenance and shall not include replaceable cartridges
6. The valves shall be available with optional pressure/temperature ports to allow flow verification.

2.34 STEAM CONTROL VALVES

A. Steam control valves shall be rated for the highest system pressure and temperature and shall not lift when subjected to that pressure with the control system set to “fully closed.”

B. All steam control valves shall be pneumatically or electrically actuated and have a flanged or screw body with a rating of 475°F or higher, as appropriate. Trim shall be rated for 475°F.

C. Use high performance segmented V-ball control valves for all steam control applications. Steam valves shall have the following characteristics:

1. Leakage Class: ANSI Class IV, minimum
2. Flow Characteristic: Equal Percentage
3. Rangeability: 300:1 turndown

D. Steam control valves shall have an equal percentage or modified characteristic depending on the converter pressure rise.

E. On steam control valves with a normal differential pressure of 15 PSIG or greater, stainless steel noise reducing trim shall be used.

F. Acceptable Manufacturers:

1. Fisher
2. Neles
3. Valve Solutions, Inc

G. Fail positions shall generally be as follows:

1. Heat Exchangers/Converters: Normally closed spring return (to protect for high temperature).
2. Clean Steam: Normally closed spring return.
3. Humidifiers: Normally closed spring return.

2.35 DAMPER ACTUATORS

A. General: Size actuators and linkages to operate their appropriate dampers or valves with sufficient reserve torque or force to provide smooth modulating action or two-position action and adequate close off rating as required.

B. For AHU/Duct mounted dampers:

1. Actuators shall be electronic.
2. Standard Electronic Actuators: Shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have a positive positioning circuit and selectable inputs. Full stroke shall be within 90 seconds. Where fail positions are required, provide spring return on the actuator with adequate close off force.
3. Acceptable Manufacturers:
   a. Belimo

C. For terminal unit dampers:

1. Standard Electronic Actuators: Shall be designed for a minimum of 60,000 full cycles at full torque. Provide stroke indicator. Output to modulating damper actuators shall be analog.
2. Fast Acting Electronic Actuators: Provide fast acting electronic actuators for VAV terminals on fume hood and associated tracking zone dampers. These actuators shall move full stroke in less than one second. Output to modulating dampers actuators shall be analog.

2.36 CONTROL PANELS

A. Enclosures

1. Enclosures located in mechanical rooms shall be NEMA 4.
2. Enclosures located in labs and other relatively dust free and dry spaces may be NEMA 1.
3. Enclosures shall be mounted on walls or free-standing supports.

B. Power Supplies

1. The Contractor shall provide a regulated, protected power supply as required with the ability to produce at least 33% more current than required by the transmitters and controls being installed. Output regulation shall be less than 0.5mV. There shall be no overshoot on turn on or off. Operating temperature shall be -20 to +70ºC.
2. The BACS Contractor shall certify, in writing, at the time of shop drawing submittal that the DDC equipment provided will not cause, as a result of its operation, either directly or indirectly, electrical interference to be induced into the building's electrical power systems.
3. Class II transformers shall be used.

C. Panel Fabrication

1. The Contractor shall size the panel such that no more than 80% of the surface of the enclosure back plate is used.

2. Plastic wire way (e.g., Panduit) shall be used to organize all wiring in the panel.
3. Sufficient wire way shall be provided in the panel such that it is filled no more than 80% capacity.
4. Panel layout and construction shall be neat and professional.
5. All controllers, wiring, and components in the panels shall be labeled. All labeling shall match the reference numbers on the cabinet drawings that shall be provided for each panel.
6. Label the power source and circuit number for each panel.

PART 3 – EXECUTION

3.1 FUNCTION

A. Provide all components necessary to achieve the Sequences of Operation listed in Part IV and any additional industry standard functions normally required of a first class BMS/ATC installation.

B. This division shall provide a project manager who shall, as a part of his duties, be responsible for the following activities:

1. Coordination between this Contractor and all other trades, Owner, local authorities and the design team.
2. Scheduling of manpower, material delivery, equipment installation and checkout.
3. Maintenance of construction records such as project scheduling, manpower planning, and as-built drawings for project coordination and as-built drawings.

3.2 INSTALLATION METHODS

A. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Electrical sections of these specifications.

B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devices.

C. Control Wiring:

1. Number-code or color-code conductors appropriately for future identification and servicing of control system.
2. All line voltage power wiring required because of substitution of low voltage power wiring equipment specified in this division, shall be provided by this division.
3. Comply with the applicable requirements of Division 26 for the installation of electrical wiring incidental to the temperature control system.
4. Comply with the applicable requirements of National Electrical, New York City Building Code, and Building Code for the installation of electrical wiring incidental to the temperature control system.
5. Control wiring shall be run in conduit in accordance with the electrical sections of this specification.
6. Conduit shall be run parallel to building lines properly supported and sized at a maximum of 40% fill. In no cases shall field installed conduit smaller than ½" trade size be allowed.

Where conductors are not in conduit, cable rated for use in return air plenums shall be used.

7. BMS/ATC division shall provide all control transformers and all control wiring (including low voltage actuator power wiring). This division shall also provide power wiring from the control circuits to the transformer locations and all other temperature control devices requiring power wiring. Electrical Contractor shall furnish appropriate control circuits (both normal and emergency) in suitable panelboards located throughout the project.
8. BMS/ATC division shall provide UL listed surge protectors for all control circuits upstream of control transformers.

D. Equipment installed under other divisions of the specifications:

1. Furnish dampers, valves, temperature sensor wells, flow switches and other equipment to Installers at proper time.
2. Provide installation instructions.

E. Adjust low-leakage dampers so all gaskets and seals are properly compressed.

F. Provide outside air and relative humidity sensors at each outside air intake louvers for air handlers.

G. Unless specifically indicated on plans, do not install wall mounted thermostat or temperature sensor on exterior wall. For thermostats or temperature sensors located on an exterior wall, provide insulated base behind device.

H. The access panels or doors shall be a minimum size of 18 x 18 inches.

I. Devices (i.e., sensors, meters, instruments, etc.) that are resettable must be installed in a readily accessible location (e.g., the device must be accessible at floor level without the use of a ladder). No device shall require shutting down a building system for calibration.

J. Devices that are installed in an exposed location (i.e., not mounted within a cabinet) must be suitable for such installations (e.g., do not install a device that is intended to be installed in a cabinet in an exposed location).

K. Control panels and enclosures housing the controllers shall be coordinated to the extent possible, to share vertical and horizontal wire-ways to facilitate and minimize the cost of home-runs to terminal equipment. All penetration of the controller enclosure within mechanical rooms shall be from the bottom of the enclosure with wireway and conduit stubs from the wireway up to the panel.

L. Control panels shall be located in equipment rooms, where practicable, and in locations maintaining ambient conditions between 50 and 90°F and 10 to 85% relative humidity. Control panels located in areas where conditions are outside of these ranges shall have enclosures outfitted with heating or cooling devices to provide the proper environmental conditions. Hoffman style enclosures with removable back plates and keyed, hinged covers shall be used. Enclosures shall be rated NEMA 4 when located in mechanical spaces and NEMA 1 when located in occupied spaces. Provide enclosures with key lockable doors.

M. All transformers and power supplies shall be mounted outside of the central panel.

N. Fabrication

1. The Contractor shall size the panel such that no more than 80% of the surface of the enclosure back plate is used.
2. Plastic wire way (e.g., Panduit) shall be used to organize all wiring in the panel.
3. Sufficient wire way shall be provided in the panel such that it is filled no more than 80% capacity.
4. Panel layout and construction shall be neat and professional.
5. All controllers, wiring, and components in the panels shall be labeled. All labeling shall match the reference numbers on the cabinet drawings that shall be provided for each panel.
6. Label the power source and circuit number for each panel.

3.3 IDENTIFICATION

A. Devices Inside Panels: Either of the following:
1. Engraved labels.
2. Lettered in permanent ink with felt tip marker.

B. Exposed Devices: Engraved labels.

C. Location: On the body of the device or on the surface to which it is mounted.
1. Do not put identification on removable covers.

D. Label each remotely mounted control panel as to the device it controls.

3.4 OPERATING AMBIENT CONDITIONS

A. Electronic controls mounted in unconditioned space shall be rated for ambient operating conditions from -40°F to 155°F. Controls not meeting these limits shall be mounted in an accessible location within conditioned space.

3.5 OWNER TRAINING

A. The BAS/ATC contractor shall provide 4 copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the temperature control and Building Automation System supplied. This contractor shall instruct the owner's designated representatives in these procedures during the startup and test period. The owner training shall consist of a minimum of three (3) 8 hour instruction periods scheduled by the owner over the first 12 months of system operation. The training shall be scheduled during normal working hours.

B. Follow up training shall be provided under this Division for two (2) eight hour instruction periods at six months and twelve months after building acceptance.

C. Provide minimum 40 classroom hours of factory training in programming and use of the BMS/ATC system for each of two people (designated by Owner). Provide room and board for trainees class during this period if factory is located more than 30 miles from the project. Provide this training no more than eighteen months after building acceptance.

D. Upon completion of the work and acceptance by the Owner, factory representatives of the control manufacturer shall provide instruction to the Owner's operating personnel who have responsibility for the mechanical systems and controls installed by the contractor. The amount of training that is provided shall match the size of the project (e.g., no less than eight hours for small projects and up to 80 hours for large projects).

E. The contractor shall make available to the Owner regular, scheduled training courses for ongoing training of the Owner's operating personnel. Programs shall include hardware- and software-oriented courses as well as energy conservation and management courses.

F. In addition to the normal training listed above, all vendors will be required to provide two weeks of training at the BACS manufacturer's training facility for four people. This training only needs to be provided once for a particular set of installed BACS products. If a contractor has provided this training previously (on a previous project or directly with the Owner) then the additional training does not need to be provided again.

3.6 CALIBRATION AND ADJUSTMENTS

A. After completion of the installation, perform final calibrations and adjustments of the equipment provided under this contract and supply services incidental to the proper performance of the ATC and BAS system under warranty below.

3.7 OPERATION BY OWNER

A. Owner may require operation of part of the system prior to final acceptance. Operation is not to be construed as acceptance of work.

3.8 ACCEPTANCE PROCEDURE

A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative.

B. Upon completion of the calibration, Contractor shall startup the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Test shall include a 100% point to point check-out of all BMS devices to confirm proper response to manual input. Installer shall be responsible for generating all software and entering all database necessary to perform the sequence of control and specified software routines. An acceptance test in the presence of the Owner's representative or Architect shall be performed.

1. If more than two of the first 10 devices tested, or more than 10%of the first 20 or more devices tested, fail to operate properly, the test shall be discontinued.
2. Additional testing, after corrections are made, shall be done at the Installer's expense.

C. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.

D. Field Equipment Test Procedures: DDC Zone and Local Controllers shall be demonstrated via a functional end-to-end test as follows:

1. All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operations verified. (Point -to- Point Checkout)
2. All analog input channels shall be verified for proper operation.
3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displayed value.
4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.
6. Selected time and setpoint schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.

E. Workstation Test Procedures: The System Workstation test procedures shall be as follows:

1. Communication with each DDC Zone and Local Controller shall be demonstrated.
2. Operator commands will be explained and demonstrated.
3. Control sequences shall be demonstrated for proper operation.
4. All available system reports and logs shall be demonstrated at the System Workstation.
5. Correct system start-up and shutdown procedures shall be demonstrated.
6. All controllers shall be demonstrated to operate in standalone mode.

F. Acceptance Test of Mechanical Systems

1. Perform at least two (2) operational tests of the entire mechanical system as described in the specifications.
2. Give each element of the system an operating test of not less than 48 hours' duration to demonstrate to the satisfaction of the Architect that the control system is functioning properly and that the system is capable of producing the required environmental conditions. During this test, operate the system entirely on automatic control and take periodic readings of the inside and outside wet and dry bulb temperatures. Obtain wet and dry bulb temperatures with a recording thermometer-hygrometer. Conduct tests with outside temperature and humidity conditions as near design conditions as practical.
3. Winter acceptance test shall be conducted when outside temperatures are at or near 10^0F, summer acceptance test shall be conducted when outside temperatures are at or near 90^0F db.
4. Conduct tests during summer and winter outdoor temperature extremes as specified above. Notify Owner seven (7) days in advance of proposed tests.
5. Record temperature and humidity at an exterior and interior location for each system as designated by the Engineer at least once every hour for 48 hours during tests.
6. Submit a report detailing the following:
   a. Instrument used:
      1) Most recent calibration date.
   b. Date of tests.
   c. Description of test apparatus locations and methods.
   d. Results of tests.
   e. Any abnormal usage of the building or abnormal system characteristics observed during the course of the test.

3.9 RECORD DOCUMENTS

A. Electronic Media As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply complete 11X17 hard copy as-built drawing sets, together with CD's to the owner. Provide (3) copies of O & M Manuals.

B. Operation and Maintenance Manuals: Submit Operation and Maintenance manuals. Include the following in each manual:

1. BMS/ATC information for insertion into the Manufacturer's catalog data and specifications on all sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals, and any miscellaneous components used in the system.
2. An Operator's Manual which will include detailed instructions for all operations of the system.
3. An Operator's Reference Table listing the addresses of all connected input points and output points. Settings shall be shown where applicable.
4. A Programmer's Manual which will include all information necessary to perform programming functions.
5. A language manual which will include a detailed description of the language used and all routines used by the system.
6. Flow charts of the control software programs utilized in the Temperature Control System.
7. Complete program listing file and parameter listing file for all programs.
8. A copy of the warranty.
9. Operating and maintenance cautions and instructions.
10. Recommended spare parts list.
11. Twenty-four (24) hour service phone number and point of contact.
12. Controlled Schematic Drawings.
13. Detailed written sequences of operation.
14. Valve, damper, and laboratory airflow devices schedules.
15. Floor Plans.
16. Wiring Diagrams.
17. Sample Graphics and Trends.

3.10 WARRANTY

A. All BAS/ATC devices and installation shall be warranted to be free from defects in workmanship and material for a period of one year from the date of job acceptance by the owner. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the owner. Factory authorized warranty service shall be available within 50 miles of jobsite.

B. Except as otherwise specified, the Contractor shall warrant and guarantee all work against defects in materials, equipment, and workmanship for a period of one (1) year from the date of acceptance of the work as evidenced by a resolution to that effect by the Owner, and for that period of time noted in special or extended warranties.

C. The period of one (1) year shall be extended with respect to portions of the work first performed after substantial completion by the period of time between substantial completion and the actual performance of the work.

D. The Contractor shall provide all recommended preventative maintenance of the materials, equipment, and workmanship as necessary and as described in the operating and maintenance manuals during the warranty period. In addition, the Contractor shall provide two (2) semi-annual service visits (i.e., one visit during the peak cooling season and one visit during the peak heating season) to test and evaluate the performance of the equipment. The Contractor shall provide a written report of the test and evaluation results. The service visits shall include, but not be limited to:

1. Checking and, if necessary, correcting the calibration of the sensors, transducers, and transmitters for airflow, liquid flow, pressure, temperature, and humidity.
2. Checking and, if necessary, correcting the operation of the dampers and damper actuators.
3. Checking and, if necessary, correcting the operation (i.e., monitoring and command) of the system points.

E. Software and Hardware Updates: At the end of the first six months after acceptance, and during the subsequent six month period, the BACS contractor shall update the equipment and any controllers, servers, workstations and HMI web servers with the latest modification and improvements in software, firmware, and hardware that the manufacturer may have incorporated in the furnished equipment.

3.11 INSPECTION

A. Examine location where controls and equipment are to be installed and determine space conditions and notify architect in writing of conditions detrimental to proper and timely completion of the work.

1. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.12 INSTALLATION

A. Install in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that equipment comply with requirements and serve intended purposes.

B. Coordinate with the work as necessary to interface installation of equipment with other components of systems.

3.13 FIELD QUALITY CONTROL

A. Upon completion of installation of the automatic temperature control system and after motors have been energized with normal power source, test system to demonstrate compliance with requirement. When possible, field correct malfunctioning controls then retest to demonstrate compliance. Replace controls which cannot be satisfactorily corrected. Refer to Testing and Balancing Section of this specification.

3.14 SERVICE

A. After completion of the control system installation, the control manufacturer shall regulate and adjust all temperature sensors, control valves, damper motors, etc., and place in complete operating condition, subject to the approval of the Architect. The control contractor shall provide

two complete instruction manuals, in addition to any other manuals called for in this specification, to the Owner's operating personnel. The manual shall include the function and operation of all control components on this project. Complete instructions shall be given to the operating personnel. There shall be two day's instruction given for Winter cycle and two day's instruction for Summer cycle operation.

3.15 SUBMISSION REQUIREMENTS

A. Control Schematics

1. BACS legend and abbreviations.
2. BACS one-line Architecture diagram.
3. Point names and types.
4. Normal position of output devices.
5. Setpoints.
6. Point addresses and device ranges.
7. Bill of materials listing all devices and manufacturer numbers.

B. Point and Alarm List

1. Point type (AI, BI, AO, BO, BV, AV)
2. Specific input points that must be able to be put in test mode to facilitate commissioning.
3. Listing, for each point, of any associated alarms. Control loops shall an adjustable setpoint deviation alarm based upon error and time. The alarm parameters shall be the state the point is in to cause a particular including whether the source system is also enabled. Examples of points in this list are as follows:
   a. Supply air temperature (AI) +/- 4°F from setpoint for 30 minutes.
   b. Space air temperature (AI) +/- 4°F from setpoint for 30 minutes, baseboard radiation heating system is enabled.
4. Listing, for each point, of its trending and scheduling requirements.
5. Listing of whether the point is to be included on the BACS graphics.
6. Point address.

C. Sequences of Operation

1. Sequences in all modes of operation: on, off, occupied, unoccupied, warm-up, cool-down, night setback, summer, winter, economizer, etc.
2. Sequences shall be organized into logical groupings including: run/stop, pressure, economizer, coils, discharge air, humidification, dehumidification, hydronic temperature, etc.
3. Detailed steps during mode switches.
4. Details of operation during and after a power outage. Loss of status associated with power outages are not to be indicated as failures with a subsequent alarm or lock out.
5. Specific direction on failure scenarios for loss of proof and all safety device trips.
6. Setpoints, trip points, and ranges.
7. Fire/smoke control system interfaces.
8. Schedule of operation, including holidays and breaks.
9. Fire alarm panel interlocks and special operating modes.

D. Valve Schedule

1. Manufacturer and Model Number.
2. Valve Size, valve type, and CV Rating.
3. Actuator and Model Number.
4. Type (2-way, spring return/non spring return, etc.)
5. Flow and pressure drop at design maximum flow.
6. Normal positions.
7. Position of valve at design conditions.
8. Close off rating.
9. Valve characteristic = (i.e., equal percentage, linear, etc.)
10. Valve turndown.
11. Design Flow.
12. Design controlled circuit pressure differential range (BACS vendor only, coordinated with the submittals).

E. Damper Schedule

1. Manufacturer and Model Number.
2. System Served.
3. Damper Size and Leakage Class.
4. Actuator and Model Number, Pilot (Y/N), Range and Mounting Position.
5. Size and Type (parallel blade/opposed blade, etc.).
6. Design flow and pressure drop.
7. Normal positions.

F. The BACS vendor shall submit manufacturer's technical product data for each control device, panel, controller, and accessory furnished indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation, start-up, calibration, and maintenance instructions as well as all cable and tubing requirements.

G. System architecture one-line diagram indicating schematic location of all controllers, workstations, LAN interface devices, gateways, etc. The ACS vendor shall indicate address and type for each control unit; as well as indicate physical media, protocol, communication speed, and type of each LAN.

H. Set of floor plans with all controllers/control panels, sensors, operator workstations, interface devices, UPS's, etc., located and identified. The BACS vendor shall indicate all network components (repeaters, routers, etc.); network wiring shall be shown and identified on the floor plan drawings.

I. Detailed Wiring Diagrams: The BACS vendor shall include detailed wiring. Indicate all required electrical wiring. Wiring diagrams shall include both ladder logic type diagrams for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on the system schematic. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. All wiring of related components that make up a system shall be grouped together in one diagram (e.g., all wiring diagrams for the components and devices on a particular AHU shall be shown on one drawing. The supply fan components and devices should not be shown separate from return fan components and devices, etc.).

J. Operation and Maintenance Materials: The BACS vendor shall provide Operation and Maintenance (O&M) materials generally in concert with training. O&M materials shall include the following:

1. Maintenance instructions and spare parts list for each type of control device, control unit, and accessory.
2. BACS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripheral.
3. BACS Programming Manuals for each controller type and for all workstation software.
4. All information provided during the submittal phase; updated with as-built information. As-built panel drawings shall also be included as part of the O&M manual process. The drawings that are located in each panel shall incorporate all the systems controlled from that particular panel. The drawings shall include the system schematic and detailed panel wiring diagram. Also included (typically noted on the system schematic diagrams) should be the specific locations of any remote devices such as remote static pressure sensors, differential pressure sensors, etc.
5. Each control panel on the project shall include an as-built hard copy of all drawings and documentation associated with that panel and its field devices. This documentation shall be provided in a plastic protective pocket mounted inside the panel door.
6. The final as-built controls drawings (PDF) shall also be accessible via the web based graphics.

PART 4 – SEQUENCE OF OPERATION

4.1 GENERAL

A. BMS/ATC Contractor shall design, install, program, test, commission and demonstrate a complete and fully functional system capable of meeting the Sequences of Operation detailed below. Provide additional control points and functions as required, even if not specifically called for, if normally considered necessary for a BMS/ATC installation of the size and complexity of this project or if required to implement control sequence.

B. Listed items of equipment shall be individually controlled by standalone controller. Each controller shall serve only one individual unit. The unit controller shall be supplied by the BMS Contractor and may be furnished to the equipment supplier for factory mounting. The cost to mount, calibrate, program and test the controller and actuator shall be coordinated prior to bid day and included in the BMS price.

1. VAV Box.
2. VRF System.
3. Convectors.
4. Package Rooftop Unit.

C. Multiple units may be controlled by individual standalone controllers for all other control points.

D. Sensor and transducer installation, control power and wiring and communications wiring shall be provided under this division by BMS/ATC Contractor.

E. Refer to the Systems Points List at the end of this division and equipment schedules on the drawings for required control inputs and outputs for each item of equipment listed in the Sequence of Operation.

F. Where control sequences depend on global variables such as outside air temperature, the controller shall have the capability of either using the last value or a default value.

1. All points and functions required to control an air handler with all directly associated supply, return, and exhaust fans. This excludes the terminals that may be associated with that air handler. Values that may be received across the network include humidity, emergency power source indication, terminal based reset parameters, and smoke modes.
2. All points associated with the supply side of a hydronic system such as pumps, flow meters, temperature and pressure sensors, proof indications, valves etc. This excludes the terminals on that hydronic system. Values that may be received across the network include outside air temperature and humidity, emergency power source indication, and terminal based reset parameters.
3. All points and functions required to control one terminal system including dampers, valves, flow meters, temperature and humidity sensors, etc. This does not include the scheduling period or any outside air that may be necessary for control.

G. Trending: To support commissioning and building data mining, the BACS shall be capable of trending and archiving all points on building- and system-level controllers at a minimum of 15 minute intervals. The BACS shall also have the capability of trending at least five points on each field-level controller at an interval of 15 minutes. The trend data shall be uploaded to a central database as needed to prevent buffer overflow in the controller. Controller memory capability, network architecture, and communications bandwidth shall be designed to account for this trending. The BACS vendor shall provide control trends during start up and prior to functional performance testing of the systems. Reports shall be scheduled to output the data to a common format such as comma separated text, Microsoft formats such as Excel and Access, and portable database format. Trended data shall also be archived in an Owner-accessible SQL database.

H. Trend Graphs: Web-based software shall provide for displaying graphic plots of the trended values. The software shall support multiple scales, points and point types simultaneously. The BACS vendor shall configure these graphs in a logical manner for each system. Consult with the commissioning team members and project manager for required configuration. Provide a trend for every analog control loop that includes the setpoint, process variable, and control output.

I. Alarms: All alarms shall be provided with a means of output as an e-mail and a text message through an owner provided internet connection. User interface shall include all provisions and screens required for the end-user to select which alarms shall output as an e-mail or text message without the involvement of a service technician.

J. Real-time Plotting: Software shall be provided for real time plotting/graphing of multiple values in user-defined time intervals. These graphs will typically be used in commissioning to observe loop responses and system reactions. The BACS vendor shall configure these graphs in a logical manner for each system. Consult with the commissioning team members and project manager for required configuration.

K. Web-based Graphics:

1. Floor Plan Screens.

a. Provide floor plan screens for each floor and/or section of the building. Indicate the location of all equipment that is not located on the equipment room screens. Indicate the location of temperature sensors and VAV boxes associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHU's etc.) on the floor plan screens.
b. Display the space temperature point adjacent to each temperature sensor symbol. Indicate room numbers as provided by the owner. Provide a graphic link from each zone and/or equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.
c. Provide floor plan screens for each mechanical equipment room and, if mechanical equipment is situated there, the roof. Indicate the location of each item of mechanical equipment. Provide a link from each equipment symbol shown on the plan view screen to each corresponding mechanical system schematic graphic.
d. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link the graphic building key plan to larger scale partial floor plans. Provide links from each larger scale floor plan graphic to the building key plan and to each of the other graphic floor plan screens.
e. Provide a graphic site plan with links to and from each building graphic.
f. All points indicated on control details shall be displayed on graphic.

2. System Schematic Screens:

a. Provide graphics for each air handling system. Indicate OA temperature and relative humidity, and mode of operation as applicable (i.e., occupied, unoccupied, warm-up, cool-down, etc.). Link screens for air handlers to the heating system and cooling system graphics. Link screens for supply and exhaust systems, if they are not available in a single graphic.
b. Each I/O point in the project shall appear in at least one graphic. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc., as applicable. General layout of the system shall be schematically correct. I/O devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the cursor. Indicate all adjustable setpoints on the applicable system schematic graphic or, if space does not allow, on a supplemental linked setpoint screen. All outputs shall be represented in terms of percent open and include a pop-up link to the control logic.
c. Provide a system schematic graphic for each HVAC subsystem controlled.
d. Provide a graphic for each hydronic system.
e. Provide a graphic for each terminal unit. In addition to points associated with the unit, indicate mode of operation as applicable (i.e., normal occupied, unoccupied, warm-up, maximum heating, maximum cooling, etc.). Provide links between the applicable floor plan screen and this screen. Also provide links to the graphics representing the parent systems.

f. Link screens for heating and cooling system graphics to utility history reports showing current and monthly energy usage, demands, peak values, etc.
g. Link screens to all schedules and setpoints.

L. Alarm Programming: Alarms shall be "intelligent" based upon the algorithms in this section.

1. In general, alarm programming related to DDC controlled equipment should reside at the controller level along with the functional programming for equipment control.

a. Intrinsic alarming associated with AI, AV, BI or BV objects (or any of the other 23 BACnet objects that support intrinsic alarming) shall only be used where the alarm is valid regardless of the state of the associated equipment or where there is a ready means for automatically suppressing alarm generation when the associated equipment is operationally secured.
b. Alarm points shall be separate BACnet objects (e.g., BV or EEO) actuated by associated alarm programming.
c. Alarm objects shall have descriptive BACnet object names. BACnet alarm object names shall end in "Alarm". For detailed information on proper point naming conventions, coordinate with owner's Facilities and Engineering staff.
d. If it is necessary for the alarm to have latching functionality, the user shall be provided easy unlatching capability from within the DDC system if appropriate, taking into account equipment safety concerns. This is in addition to any local alarm reset.
e. Alarms designated for monitoring by EMCS shall be set up in the DDC system to report to the EMCS alarm server.

2. Analog Deviation Alarms: Analog deviation alarms shall be based upon the comparison between the controlled variable and the controlled variable setpoint (whether calculated or fixed).

a. When controlled variable deviates from setpoint above or below user adjustable high or low alarm thresholds, the alarm shall be activated.
b. High and low alarm threshold values shall have associated adjustable deadbands (hysteresis values) for alarm clearing conditions as the controlled variable falls below the high alarm threshold or rises above the low alarm threshold.
c. Alarm programming shall include user adjustable alarm delays for active equipment operation.
d. Alarm programming shall include startup delays to prevent nuisance alarms during equipment startup.
e. Analog deviation alarms shall be disabled if the associated equipment is operationally secured.

3. Analog High Limit Alarms: Analog high limit alarms shall be based upon the comparison between the controlled variable and a user adjustable high limit alarm value.

a. When controlled variable rises above the user adjustable high limit, the alarm shall be activated.
b. High alarm limit value shall have associated adjustable deadband (hysteresis value) for alarm clearing condition as the controlled variable falls below the high alarm limit.
c. Alarm programming shall include user adjustable alarm delays.

d. High limit alarms shall be disabled if the associated equipment is operationally secured, unless needed due to equipment safety considerations.

4. Analog Low Limit Alarms: Analog low limit alarms shall be based upon the comparison between the controlled variable and a user adjustable low limit alarm value.

a. When controlled variable falls below the user adjustable low limit, the alarm shall be activated.
b. Low alarm limit value shall have associated adjustable deadband (hysteresis value) for alarm clearing condition as the controlled variable rises above the low alarm limit.
c. Alarm programming shall include user adjustable alarm delays.
d. Low limit alarms shall be disabled if the associated equipment is operationally secured, unless needed due to equipment safety considerations.

5. Binary Run Status Alarms: Status alarms shall be based upon the comparison between run status and equipment command where applicable.

a. Alarm Status programming shall include user adjustable alarm delays.

6. Binary Alarming: Alarms shall be triggered upon associated BI changing state to the non-normal or alarm state.

a. Alarm Status programming shall include user adjustable alarm delays.
b. Binary alarms shall be disabled if the associated equipment is operationally secured, unless needed due to equipment safety considerations.

7. Steam Shell and Tube Heat Exchanger Temperature Alarming: Steam shell and tube heat exchangers shall have two temperature alarms associated with them.

a. Operational Supply Temperature Deviation Alarm when heat exchanger is in operation.
b. High Supply Temperature Alarm that is always enabled whether or not the heat exchanger is operational or not, so as to monitor for steam control valve leak by.

4.2 OCCUPANCY SCHEDULES

A. Scheduled Occupancies

1. Occupied during expected occupied period
2. Unoccupied during expected occupied period.
3. Occupied during expected unoccupied period.
4. Unoccupied during expected unoccupied period.

B. Unscheduled Occupancies

1. Vacant
2. Occupancy pending
3. Occupied within past 2 hours.

C. Each room or space shall be provided with an individual heating or cooling setpoint or may participate in global setpoint values for each occupancy condition.

D. Any device utilizing on/off control or scheduling shall be capable of being programmed to conform to any of these schedules.

4.3 BUILDING LEVEL

A. At a minimum, monitoring at the building level shall consist of the following points.

- Outside Environment:
  - Outside air temperature (OAT)
  - OA dewpoint
  - OA enthalpy (calculated)
- Steam Service:
  - Steam pressure (leaving PRV)
  - Condensate flow, pulse

B. When power returns, the systems in the building shall be restarted in priority of criticality with a slight timing delay between starts to minimize the inrush power requirements.

4.4 BACS REQUIREMENTS FOR ZONE LEVEL CONTROL

A. General

1. This section of the guideline defines general physical Input/Output (I/O) requirements, sequences, and by inference some degree of system requirements related to how the BACS is applied to zone level control.
2. As a minimum, all zones of control will require a space sensor.
3. Without exception, temperature sensors shall correlate with the controlled zone. In zones where both heating and cooling systems are designed, it is especially important to coordinate the heating and cooling control zones.
4. Override buttons provided with sensors shall as a minimum perform the following functions:
   a. Return the zone to occupied mode and enable the equipment that serves the zone (e.g., the central air handling unit and the zone VAV box). All other zones that are not occupied shall remain at unoccupied flow setpoints, as applicable.
   b. For single zone units, the AHU (or other terminal system) serving the zone shall start and run in the occupied mode.
5. Zone temperature control shall, unless indicated otherwise, include a 5 ˚F deadband between heating and cooling setpoints to minimize energy use and avoid "fighting."
6. In all cases, the heating and cooling within a zone must be coordinated to avoid simultaneous heating and cooling.
7. Generally, controllers serving zone terminal devices shall be field-level controllers fed from normal power. Tracking laboratories will require system level controllers fed from emergency power.

8. Fail position on the systems that serve these standard environments will generally fail to either last condition/position or heating where there is a perimeter wall or some need for heating. Where there is not a need for heating, such as in an internal zone, systems shall fail to either last position/condition or to cooling.
9. Occupied, occupied setback, and unoccupied temperature setpoints shall be designated on the design control drawings. Occupied setback mode is used where a defined building occupancy schedule is used in conjunction with occupancy sensors. A typical space temperature setpoint reset schedule is as follows:

    a. Space Cooling Temperature Setpoints:

    Occupied: 75˚F ± 1.5˚F 0+
    Occupied Setback: 75˚F + 3.0˚F
    Unoccupied: 75˚F + 6.0˚F

    b. Space Heating Temperature Setpoints:

    Occupied: 70˚F ± 1.5˚F
    Occupied Setback: 70˚F – 3.0˚F
    Unoccupied: 70˚F – 6.0˚F

10. In addition to the temperature setpoint reset, during the occupied setback mode, the minimum airflow setpoint shall also be reset to 50% of the occupied flow setpoint.

B. Conference/Meeting Zones

1. Control for meeting areas must be closely coordinated with the system design, but shall include temperature and ventilation control. Space control data shall be available on the BACS network.
2. Control shall include maintaining space temperature in the comfort range as defined by ASHRAE. Adequate ventilation shall be ensured by either occupancy sensing and indexing the ventilation to the ASHRAE 62 prescribed value upon occupancy, or by active control of CO2, modulating ventilation rates to maintain space CO2 below 900 PPM. Occupancy sensing shall generally be used for smaller facilities while active control will typically be used for larger facilities.

C. Office Zone Control

1. Control shall include maintaining space temperature in the comfort range as defined by ASHRAE. Generally, ventilation shall be provided by a dedicated ventilation system, with sufficient capacity and condition to offset the expected space latent gains.
2. Generally, using VAV with reheat is limited to modifications to existing systems.
3. For zones with passive radiant heating and cooling systems, the typical occupied, occupied setback, and unoccupied temperature setpoint reset schedule shall be modified. Our experience shows that the following reset schedule is sufficient to maintain proper comfort levels given the slower response speed of these types of systems:
    a. Space Cooling Temperature Setpoints:

    Occupied: 75˚F ± 1.5˚F
    Occupied Setback: N/A
    Unoccupied: 75˚F – 4.0˚F

b. Space Heating Temperature Setpoints:

Occupied: 68˚F ± 1.5˚F
Occupied Setback: N/A
Unoccupied: 68˚F – 4.0˚F

4.5 VAV ROOFTOP UNIT

A. If communication with the BAS is lost, the air handler controllers shall use their default setpoints and operate in the Occupied mode.

B. Occupied Mode:

1. When the rooftop unit is in the Occupied Mode, the Supply Fan shall operate continuously. The Supply Fan variable frequency drive shall modulate to maintain the Duct Static Pressure.

C. Unoccupied Mode:

1. When the rooftop unit is in the Unoccupied Mode, the Supply Fan shall be OFF. The Outside Air Damper shall be closed.

D. Night Setback Mode:

1. Supply fan to operate at minimum air flow, maintain set-back space temperature setpoint offs) or lowest associated zone T-stat.
2. Outside air damper to be at minimum.
3. Maintain a 6°F (adj.) offset to setpoint:
   a. Energize heat fully and energize fan at offset. Run until setpoint is reached, then de-energize fan and electric heat.
4. Operate terminal units in "Morning Warm-Up Mode", modulate variable frequency drive to maintain duct static pressure.

E. Morning Warm-Up Mode:

1. Supply fan shall run continuously and be energized one hour (adj.) prior to scheduled occupied mode start. Energize heating to warm-up occupied space to occupied setpoint of all associated space stats.
2. O.A. dampers shall be closed.
3. Cooling shall be locked out.
4. Energize heat fully until setpoint(s) are satisfied, maintain a 95°F (adj.) discharge air temperature.
5. Revert to occupied mode when all space stats have reached occupied heating setpoint.

F. Fan Safety Controls:

1. De-energize the Supply Fans whenever the Stop/Auto interlock is open, the Discharge Air Low Limit is tripped, the fire or smoke stat has tripped, or the Supply Fan Status indicates a failure (after a two minute delay). The Fire-stat, Low Limit and the Fan Failures require a manual reset.

2. Alarm the BMS with an appropriate alarm message.

G. Supply Fan Capacity Control:

1. When the Supply Fan is on, the variable frequency drive shall slowly ramp (adjustable) up to setpoint and modulate to maintain the proper Duct Static Pressure. The unit shall stop if the Static Pressure Sensors fail and alarm BMS. The Static Pressure Sensors shall be located by this Division.
2. Submit sensor locations to engineer for review.

H. Discharge Air Temperature:

1. Provide a "cascade" type reset (via a PID loop) of discharge air temperature (D.A.T.) to maintain space temperature.
2. Space humidity sensor shall override reset control and maintain humidity with highest possible D.A.T.
3. If D.A.T. drops below 40°F (adj.), de-energize all fans and close the outside air damper.

I. Electric Coil Control:

1. Electric coil shall stage on to maintain discharge air temperature.

J. Cooling Control:

1. The compressors shall modulate to maintain the Discharge Air Temperature at the Discharge Cooling Setpoint (55 F, adj.). The compressor shall be off if the rooftop unit is in the Heating mode, the Fans are OFF, or the Discharge Air Sensors have failed.

K. Relief Fan Control:

1. Relief fan variable frequency drive shall modulate to maintain building pressure of 0.05" (adj).

4.6 VARIABLE AIR VOLUME (VAV) TERMINAL UNITS

A. Refer to Air Terminal Unit specification for additional requirements.

B. Constant Volume Terminal Units

1. When the associated air handler/fan coil is operating the constant volume valve shall maintain its preset amount of outside air to the air handler/fan coil.
2. When the associated air handler/fan coil is off the constant volume valve shall close.

C. Shut-Off VAV Terminals with Heat:

1. On a rise in space temperature above the cooling setpoint, the unit shall modulate up to it's maximum CFM to maintain setpoint. As space temperature decreases, the unit shall modulate down to its minimum cooling CFM to maintain setpoint.

   As the space temperature continues to fall below the cooling temperature setpoint, the unit

shall modulate to its fixed cooling minimum CFM. At the same time, the heating coil shall maintain cooling setpoint.

2. Each VAV box shall have a ventilation setpoint input. This setpoint shall be used along with the ASHRAE Std. 62-1989, Equation 6-1 to reset the corresponding Air Handler Outside Airflow (CFM) to maintain proper ventilation for each VAV zone. See VAV air handler sequences for interface of VAV ventilation into the building automation system.

D. Morning Warm-Up:

1. When the respective air handler for a VAV box operates in the morning warm-up mode, the VAV box shall operate as a "heating air valve".
2. Maintain full cfm cooling airflow until the zone sensor is satisfied (space temperature rises). As space setpoint is reached, modulate air valve fully closed until AHU unit reverts to "OCCUPIED" operating mode.
3. Heating control valve shall be fully open.

E. Alarm the time, VAV box designation and duration of all VAV over-rides.

4.7 PRESSURE BYPASS CONTROL

A. A differential pressure controller, sensing supply water and return water pressures for its system, shall modulate a bypass valve to maintain its setting. Valve shall be normally closed for hot water and normally open for chilled water.

4.8 EXHAUST FAN CONTROL

A. When the exhaust fan is started, a normally closed damper in the fan outlet shall open. When the fan is stopped, the damper shall close.

B. For dampers furnished by the fan manufacturer, fan manufacturer shall provide electric, totally enclosed, spring return damper motors and dampers, and control manufacturer shall wire to load side of local disconnect switch.

C. For Elevator Equipment Room, provide a room temperature sensor, set at 80˚F., to cycle its respective exhaust fan motor, on a rise in temperature. When the fan starts, its outside air intake damper shall open. For two speed motors, fan shall operate at low speed below 80˚F. and at high speed above 80˚F.

4.9 DIRECT RADIATION

A. Provide room temperature sensor where shown on Drawings, to control a hot water control valve on the water supply line to each radiation element, to maintain 72˚F.

B. In rooms with direct radiation control and reheat control, a single room temperature sensor shall control the radiation and reheat coil, in sequence, on a rise in temperature.

C. Provide self-contained control valves where shown on Drawings to maintain 72˚F.

4.10 CONTROL OF SMOKE DAMPERS

A. Provide a normally closed automatic damper in each duct crossing a smoke barrier, and as indicated on the Drawings, at the point where the duct crosses the barriers and at supply fan discharge. Whenever supply fan stops, smoke damper at the fan discharge shall close. Provide one minute time delay to prevent fan start-up until all smoke dampers have opened and 20 second time delay to prevent dampers from closing until fan has stopped. All smoke detectors located at the supply, return and exhaust ductwork of same system shall be one zone. Any smoke detector actuated on the zone shall:

1. Stop supply fan and exhaust fans. (Interlocked fans shall be shut down by means of interlocking).
2. Start return air fan. (Give consideration to making this fan 2 speed starting fan at low speed).
3. Close return air damper and open relief air damper.
4. Open all smoke dampers on return air duct of that system. Whenever return air fan is off, smoke dampers on return air duct shall close. (Provide time delay as described above).
5. *Close smoke dampers in supply and exhaust ductwork. This can be done either by using E-p switch at supply fan starter or by using an E-p switch at each floor wired from same zone.

4.11 VARIABLE FREQUENCY DRIVES

A. The BACS shall provide for seamless integration with the control of the VFDs and associated systems. The interface shall be hardwired (point-by-point wiring to applicable terminations on the drives interface board) for start/stop, status and speed signals. The status shall be determined via contacts from the drive. The drive specification must be coordinated to ensure that the status contacts are available and are a true feedback indication that the motor is running. The speed signal shall be 0-10VDC. Digital communications via a controller LAN shall be used to gather all other available diagnostic information.

4.12 MOTOR STARTERS

A. An HOA switch shall be provided with the starter. In the hand position the motor shall start and run continuously unless a safety device trips; in the off position the motor shall stop; in the auto position the BACS shall control the motor per described sequences of operation.

B. Status shall be monitored by the BACS, preferably with a current sensor. Motor status shall be monitored via an adjustable de-bounce time. The BACS shall annunciate a “failure” alarm whenever the motor is commanded to run and status is not proved within an adjustable de-bounce time. In the failure mode, the run command shall remain, except on headered systems for which the run command will be removed requiring manual acknowledgement. In no case shall a loss of status coincident with a loss in power be alarmed as a failure. The BACS shall include controller arrangement and/or points or programming as required to accomplish the above.

4.13 COILS

A. General

1. Coils shall generally be controlled by a modulating valve and include a temperature sensor immediately downstream of the coil before any other coil or heat transfer element. Coil selection must be coordinated with the control design and valve selection to ensure stable control particularly at light loading conditions.

2. When heating and cooling coils are included in one supply system, programming shall prohibit simultaneous heating and cooling operation (unless required for dehumidification) and smoothly sequence the coils as loading changes. All control valves shall have dedicated analog outputs. Coil control programming shall be coordinated with all other elements that affect the temperature of the supply air to minimize the energy use.

3. Generally, sensors within an air handler shall be averaging unless they are after a well-mixed condition such as downstream of a fan.

4. Provide an alarm if there is an air temperature difference across the coil the control valve is commanded closed.

5. The discharge air temperature shall be reset in ventilation-driven systems to minimize cooling and reheat as follows:

OAT 75 °F & above => DAT = 55 °F
OAT 55 °F & below => DAT = 65 °F

B. Heating Coils

1. Heating coil control valves shall be sized for smooth and stable control.
2. Control valves on heating coils provided with a supply air handler shall close when the system is off.

4.14 DDC SYSTEM POINTS LIST

A. General: Provide individual inputs or output for each point listed in the points list (See Appendix). Provide any additional points not listed in the points list, but required to meet the sequences of operation, at no additional cost to the owner. All analog outputs shall be 4-20mA, 0-10VDC, or 0-20VDC unless otherwise indicated. AO = Analog Output; AI = Analog Input; DO = Digital (binary) Output; DI = Digital (binary) Input.

B. Points types include the following:

1. Binary Input (BI)/Digital Input (DI): An on/off indication that has a maximum cycle rate of 1 Hz. This is typically sensing a contact closure.
2. Binary Output (BO)/Digital Output (DO): A contact closure on the controller that will cause an action in the system.
3. Binary Value (BV)/Digital Value (DV): A network-visible binary point whose value is determined by a controller computation.
4. Analog Input (AI): A continuously varying voltage or amperage signal that is varied by a sensor in relation to a sensed variable. This signal is processed in the controller after an

analog-to-digital converter on the controller that converts the analog signal to a digital value.

5. Analog Output (AO): A continuously varying voltage or amperage signal that is generated from the controller after digital-to-analog conversion. The voltage or amperage signal will be used, for instance, to drive a modulating actuator or reset a hardwired setpoint on a packaged device.
6. Analog Value (AV): A network-visible analog point whose value is determined by a controller computation.
7. Pulse-Width-Modulated Output (PWM): A time-based algorithm converts a standard BO into a modulating signal. Based on the duration of the pulse, the recipient of the signal positions the device proportional to the duration of the pulse.
8. Pulsed Input (PI): A binary input with increased cycle rate capabilities, capable of directly counting and buffering pulses that may emanate from a metering device.

4.15 MISCELLANEOUS DDC CONTROL

A. See the points list for additional required alarm and status points which shall be monitored by the BMS.

B. Reference mechanical equipment schedules (especially "fans") for additional control sequences.

4.16 MISCELLANEOUS NON-DDC CONTROL

A. Chemical Treatment: Provide required field wiring interlocks.

B. Unit Heater: Cycle the unit fan from a line voltage temperature sensor to maintain temperature setpoint.

END OF SECTION 230900

SECTION 232113 - HYDRONIC PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section covers water piping carrying water at 200ºF or less, used in the following systems:

1. Heating system
2. Cooling system
3. Condensate drain system
4.

1.2 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Pipe
2. Accessories

B. Grooved joint couplings and fittings shall be shown on shop drawings and product submittals and shall be specifically identified with the applicable manufacturer's style or series number.

PART 2 - PRODUCTS

2.1 GENERAL

A. All pipe shall be new, free from scale or rust, of the material and weight specified under the various services. Each length of pipe shall be properly marked at the mill for proper identification with name or symbol of manufacturer.

B. All steel piping, except where otherwise rated, shall be standard or extra strong weight, in conformance with the ASTM A-53 Grade B seamless.

C. All brass piping shall be standard or extra heavy weight 85% red brass semi-annealed seamless-drawn, in conformance with the ASTM B-43, as manufactured by Anaconda, American Brass Co., Chase Brass and Copper Co., or Revere Copper and Brass, Inc.

D. All copper tubing shall be of weight as required for service specified, with conformance with ASTM B-88 for Type "L" and "K" tubing, as manufactured by Chase, Anaconda, Revere, or approved equal. Tubing and fittings shall be thoroughly cleaned with sand cloth and treated with an approved non-corrosive flux before solder is applied.

E. All galvanized steel piping shall be standard or extra strong weight, as specified, in conformance with the ASTM A-53 Grade B. Pipe shall be hot-dripped zinc-coated with Prime Western smelter and not wiped.

F. Fittings shall be of material conforming to the following schedule:

1. Malleable Iron Fittings ASTM A-197
2. Cast-Iron FittingsASTM A-126

3. Brass Fittings ASTM B-62
4. Solder Fittings ASTM B-88
5. Steel Welding Fittings ASTM B16.9.
6. Wrought Copper ASTM B16.22

G. Dielectric Fittings: Install dielectric nipple, coupling or flange, to prevent galvanic action between ferrous and non-ferrous piping. Dielectric fittings shall be accessible for inspection and service. Provide dielectric fittings at all connectors to dissimilar metals, including at air handling unit coil connections.

H. All fittings used at expansion loops or bends shall be extra heavy.

I. Cast-iron, malleable-iron, and bronze fittings shall be of Crane manufacturer or approved equal.

J. Flanges shall be raised face, of the same weight as the fittings in each service category. All flanges shall be drilled to "US Standard" hex nuts and washers. Bolting shall conform to ASTM 193 Grade B-7, threads Class 7 fit. Nuts shall be semi-finished hexagonal, ANSI B18.2 ASTM A194 Grade 2H.

K. Provide permanent signage on expansion tank of hydronic systems treated with chemicals that include the chemical type, concentration system volume and direction to drain to sanitary drain.

2.2 PIPE AND FITTINGS

Piping Types and Materials

Service & Location	Pipe Size	Pipe Material & Weight	Joint Type	Fitting Material
Heating Hot Water (<250°F)				
Inside Building	3" or smaller	Copper, Type L, ASTM B88	Soldered, Press Connect below 175 PSI, Brazed above 175 PSI	Wrought Copper
	4" or larger	Steel, Schedule 40, ASTM A53, Type S, Grade B	Welded	Steel
Outside Building	3" or smaller	Copper, Type L, ASTM B88	Soldered, Press Connect below 175 PSI, Brazed above 175 PSI	Wrought Copper
	4" or larger	Steel, Schedule 40, ASTM A53, Type S, Grade B	Welded	Steel
Below Ground	All Sizes	Steel, Schedule 40, ASTM A53, Type S, Grade B	Welded	Steel

Chilled Water				
Inside Building	3" or smaller	Copper, Type L, ASTM B88	Soldered, Press Connect below 175 PSI, Brazed above 175 PSI	Wrought Copper
	4" or larger	Steel, Schedule 40, ASTM A53, Type S, Grade B	Welded	Steel
Outside Building	3" or smaller	Copper, Type L, ASTM B88	Soldered, Press Connect below 175 PSI, Brazed above 175 PSI	Wrought Copper
	4" or larger	Steel, Schedule 40, ASTM A53, Type S, Grade B	Welded	Steel
Below Ground	All Sizes	Steel, Schedule 40, ASTM A53, Type S, Grade B	Welded	Steel
Refrigerant				
Inside Building	All Sizes	Copper Tube, Type ACR, ASTM B280	Brazed	Wrought Copper, 300#
Outside Building	All Sizes	Copper Tube, Type ACR, ASTM B280	Brazed	Wrought Copper, 300#
Air Conditioning Coil Condensate				
All Locations	All Sizes	Copper, Type M, Drawn, ASTM B88	Soldered	Wrought Copper

2.3 WELDING PIPING AND FITTINGS

A. All fittings for welded piping shall be as manufactured by Tube Turn, Anvil, Bonney Forge or equal as approved by the Architect. The fittings shall be of the same weight and material as the piping to which they are attached.

B. For piping 3” and larger, full size branch connection shall be made with manufactured welding tees, branch connections for less than full size, shall be made with welding tees or with Weldolet forged branch outlet fittings. Fishmounting, shaped nipples, and stubbing not permitted.

C. Welding outlet fittings shall be Weldolets as manufactured by Donney Forge, Inc., or approved equal 2 or 3 and smaller branches shall be made with thredolets as made by Bonney Forge or approved equal.

D. Welding fittings shall be of the same material and schedule as the pipe to which they are welded. Welding elbows shall be long radius pattern unless clearance conditions necessitate the use of standard radius pattern. Welding fittings shall be as made by Tube-Turn.

E. All flanges shall be welding neck flanges ANSI B16.5 ATM 181 Grade I. All systems, except where otherwise noted - 150 lbs. Class, forged steel.

2.4 STRAINERS

A. Manufacturers:

1. Design Basis: Armstrong
2. Other Acceptable Manufacturers:
   a. Mueller
   b. Sarco
   c. Hoffman
   d. Dunham Bush

B. Size 2" and Smaller: 250-lb cast iron, threaded.

C. Size 2½" and Larger: 125-lb cast iron, flanged.

D. Screens:

1. Final Screen:
   a. Material: Type 304 stainless steel.
   b. Perforations: 0.045" diameter, 233 holes per square inch.
2. Roughing Screen:
   a. Material: Carbon steel.
3. Provide roughing screens at all circulation pumps and at any additional strainers upstream of primary plant equipment such as boilers, chillers, etc.
4. Screen shall be removable without removing piping.

2.5 AIR PURGERS

A. Manufacturers:

1. Design Basis: Bell & Gossett
2. Other Acceptable Manufacturers:
   a. Amtrol
   b. Taco
   c. Thrush

B. Model: 107

C. Float actuated, non-modulating, rated at 250 psig at 250ºF.

2.6 AIR VENTS

A. Manufacturer:

1. Design Basis: Amtrol
2. Other Acceptable Manufacturers:
   a. Bell & Gossett
   b. Taco
   c. Thrush
   d. Armstrong

B. Resilient Parts: EPDM

C. Vents on Pipes Size 2" and Smaller: Model 706

D. Vents on Pipes Size 2½" and Larger: Model 706

E. Vents on Air Purgers: Model 706

F. All air vents on the chilled water system shall be rated for 300 psi at 250˚F, Armstrong Model 11-AV, or approved equal.

G. Provide manual air vents on system high points located in finished spaces and on all systems that contain glycol.

H. Provide automatic air vents on water system high points located in unfinished spaces.

2.7 PRESSURE TEMPERATURE TAPS

A. Manufacturers:

1. Design Basis: Sysco
2. Other Acceptable Manufacturers:
   a. Universal Lancaster, Inc.
   b. Petes Plug

B. Model: BNO-500, ¼" NPT, or ½" NPT.

C. Construction:

1. Body and Cap: Brass
2. Pressure: 500 psig
3. Temperature: 350ºF
4. Core: Hot water – EDPM, Glycol – EPDM, Chilled Water – Neoprene, Cold Water - Neoprene
5. Cap: Gasketed, threaded.

D. Thermometer:

1. Number required: 1
2. Dial diameter: 2"
3. Range: 0º to 220º

E. Pressure Gauge Adapter:

1. Number required: 1
2. Model: GA-125

F. Pressure Gauge:

1. Number required: 1
2. Dial diameter: 4½"

3. Range: 0 to 100 psig
4. Accuracy: ½%

G. Provide manual vents (accessible from floor) piped to sinks or floor drains for all glycol systems. This may result in significant lengths of pipe.

2.8 THERMOMETERS

A. Manufacturers:

1. Design Basis: American, Trerice
2. Other Acceptable Manufacturers:
   a. Ernst
   b. Marsh
   c. Marshalltown
   d. Weksler
   e. Weiss

B. Housing: 9” adjustable angle stem.

C. Tube: Lens front, red liquid.

D. Range:

1. Chilled water, condenser water, 0ºF to 100ºF.
2. Hot water, 30ºF to 240ºF.
3. Dual temperature water: 30 ºF to 300 ºF.
4. Dial thermometers shall be 5 inch hermetically sealed, bimetal with stainless steel cases, antiparallax dials with raised jet black figures, stainless steel stems, and brass separable sockets unless otherwise specified. Thermometers for duct mounting shall have union connections in lieu of separable sockets. Separable wells shall be stainless steel for steel pipe and brass for copper pipe. Separable wells shall be standard type for uninsulated pipe and locking extension type of proper length for insulated pipe. Stem shall extend a minimum of 2-1/2” into the fluid.

E. Thermometers for duct mounting shall have union connections in lieu of separable sockets. Separable wells shall be stainless steel for steel pipe and brass for copper pipe. Separable wells shall be standard type for uninsulated pipe and locking extension type of proper length for insulated pipe. Stem shall extend a minimum of 2-1/2” into the fluid.

F. The accuracy of all thermometers shall be within 1% of the scale range.

G. Thermowells: All thermowells for steam service shall be stainless steel and for water service shall be brass. Thermowell length shall be in accordance with ISA standards and shall include the appropriate extension to allow for pipe installation. Extension neck shall be included when required to match thermowell and insulation thickness.

H. Locking adjustable angle body and a case of aluminum or non-metallic material. Thermometer shall be secured to well by tapered bushing and not by set screws. Provide the following characteristics:

1. Scale Graduations: 2˚F.
2. Range: Select to provide a mid-scale reading at normal operating temperature.
3. Accuracy: 1%.

I. Industrial light-powered digital thermometer with adjustable-angle stem and a case of aluminum or high impact ABS plastic. Thermometer shall be secured to thermowell by tapered bushing and not by set screws. Installation shall insure that thermometer is accessible and has been adjusted to be readable from a 5-foot level as viewed from the floor. Display shall be LCD with digits a minimum of 0.5-inch high with the following characteristics:
1. Resolution :0.1 °F.
2. Range; -40 to 300 °F.
3. Sensor: Glass passivated thermistor.
4. Accuracy: 1%

J. Acceptable Manufacturers

1. Trerice
2. Weiss Instruments
3. Weksler

2.9 PRESSURE GAUGES

A. Design Basis: Trerice

1. Other Acceptable Manufacturers:
   a. Ernst
   b. Marsh
   c. Marshalltown
   d. Winters
   e. U.S. Gauge
   f. Weksler
   g. Ashcroft
   h. Or approved equal.

B. Model: 800LF Series. Liquid filled.

C. Dial Face 4½ inch diameter; 270º arc.

1. Range: As required to keep normal operating point in mid 2/3 to ¾ of dial.
   a. Use 30” vacuum to 100 psi gauge for pumps designed to operate at pressures up to 75 psig total pressure. (Total pressure = required pump-off static pressure plus scheduled pump head).
   b. Low Pressure Steam Service: 0 to 100 psig.
   c. Chilled water: 0 to 100 psig.
   d. Hot water: 0 to 100 psig.
   e. Discharge side of water pressure reducing valve: 0 to 100 psig.
   f. Low pressure valve: 0 to 30 psig.

D. Accuracy: 2% of full scale over middle of range.

E. The gauges shall have silicone filled stainless steel casings with chrome plated bezels or rims. The gauges shall have white faces with black filled engraved numerals and adjustable pointer.

The diameter of the dial shall not be less than 4-1/2 inches. Gauges shall have brass bronzed brushed rotary type movement.

F. Provide isolating ball valve, not a gauge cock.

2.10 FLOW MEASURING DEVICES (ANNULAR/VELOCITY AVERAGING)

A. Manufacturers:

1. Design Basis: Veris
2. Other Acceptable Manufacturers:
   a. Presso
   b. Barco Division
   c. Aeroquip Corp.

B. Accessories:

1. Stop valves
2. Quick disconnects
3. Caps

C. This shall be a coordinated system, including Venturi flow stations and portable master meter, supplied by one manufacturer. Each Venturi station shall be complete with pressure tap nipples, quick disconnect valve and safety shut-off valves, indented metal identification tag on chain, giving pipe side, Venturi series, station identification, and meter reading at specified flow rate. Venturi stations shall be one piece brass screwed 1/2" through 2". Sizes 2-1/2" through 8" shall consist of plated cast iron Venturi insert held between specially machined self-centering 150# steel weld neck units. Sizes 10" and larger shall be fabricated steel plated, with welding ends. Venturi size and series shall be selected so that design flow rate shall be between 10" and 40 inches of water pressure differential on a 0-50" meter with permanent pressure loss of not more than 10% indicated flow rate differential pressure. Minimum flow rates of 2-1/2 FPS are permissible. Venturi stations shall be compatible with temperatures and pressure of the system.

D. Master meter shall consist of 6" round dial, dry type meter supplied with scale reading zero to 50 inches of water differential pressure and shall be mounted in a portable water and rot-proof fiberglass carrying case complete with 10 ft. lengths of 1/4" high pressure high temperature connecting hose, quick disconnect socket valves, venting valves, installation and operating instructions and capacity curves. Master meter shall become property of the Owner.

E. Master Meter shall be high pressure, high temperature type rated at 50 psig and 400°F, Venturi looseleaf charts shall be supplied for correction to master reading for HTHW.

2.11 AUTOMATIC FLOW CONTROL VALVES (AUTOMATIC BALANCING VALVES)

A. Flows Under 3 gpm:

1. Manufacturers:
   a. Design Basis: Flow Design Inc.
   b. Other Acceptable Manufacturers: Hayes
2. Pressure Drop Range: 15 to 150 psi.

B. Flows 3 gpm or Greater:

1. Manufacturers:
   1) Design Basis: Flow Design Inc.
   Other Acceptable Manufacturers:
   2) Autoflow
   3) Griswold
2. Type: Spring loaded piston.
3. Materials and Connections: Match pipes.
4. Pressure Drop Range: 2 to 40 psi.

C. Body: DZR brass, optional Y or T body construction to allow removal of flow cartridge without breaking main piping

D. Optional Integral Shutoff:

1. Ball: Chrome plated or stainless steel
2. Stem: blowout proof wit EPDM O-ring and adjustable Teflon packing nut, optional stainless steel as well as extensions for insulation
3. Seat: Reinforced TFE
4. Handle Style: Steel lever, optional reinforced plastic tee handle for vapor seal

E. End Connections: Threaded or sweat as required. Return side shall have union connection

F. Pressure Gage Connections: Dual Pressure Temperature test ports, brass body EPDM internal seals with retained safety cap, rated 1000 PSI at 275 F. Optional extensions for insulation

G. Flow Cartridge:
1. Body: Series 300 Stainless Steel wear surface, CNC machined piston and cylinder
2. Spring: Stainless Steel
3. Calibration: Integral adjustable factory set threaded locking nut to calibrate spring compression for design flow performance throughout spring range.

H. CWP Rating: 400 PSIG

I. Maximum Operating Temperature: 250 F

J. Accuracy: Factory pre set flow +-5% over defined pressure differential range or spring range as defined by manufacturer and determined by pump head calculations.

K. Factory Test:
1. Performance: 100% spring test of all flow control cartridges at the factory to verify design performance.
2. Leak Test: Every complete valve, factory leak tested at 100 psi under water

2.12 RELIEF VALVES

A. Manufacturers:

1. Design Basis: Bell & Gossett
2. Other Acceptable Manufacturers:
   a. Taco

b. Thrush
c. Watts

B. Type: ASME

C. Size: Maximum input capacity of system at design pressure.

D. Setting: Operating pressure of system plus 2 psi.

2.13 PROPYLENE GLYCOL

A. Manufacturers:

1. Design Basis: Dow Chemical Company
2. Other Acceptable Manufacturers:
   a. Dupont

B. Model: Dowfrost

C. Type: Propylene Glycol based with corrosion inhibitors.

2.14 VENTURIS

A. Manufacturers:

1. Gerand
2. Barco
3. Presso

B. Identification:

1. Provide engraved metal tag indicating Beta Ratio or flow curve.
2. Hang on chain to clear insulation.

C. Size:

1. Select Beta ratio to provide 10” to 30” water gauge meter reading.

2.15 FLEXIBLE PIPE CONNECTORS

A. Manufacturers - Design Basis: Mason

1. Other Acceptable Manufacturers:
   a. Metraflex
   b. Flexonics
   c. Victaulic
2. Model: MFTNC, Twin Sphere 225 psi.

B. Pipe Alignment Guides:

1. Manufacturers - Design Basis: Flexonics
2. Other Acceptable Manufacturers:

a. Adsco
b. Keflex

3. Model: PG
4. Material:
   a. Spider: Steel for steel pipe, bronze for copper tubing.
   b. Ring: Steel
   c. Travel: 3”

C. Victaulic Style 177, 75, or 77 flexible couplings may be used in lieu of flexible connectors for vibration isolation and noise reduction at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.

2.16 SLEEVES

A. Steel-Pipe Sleeves: Fabricate from Schedule 40 steel pipe. Remove burrs.

B. Iron-Pipe Sleeves: Fabricate from service weight cast-iron pipe. Remove burrs.

C. Sheet-Metal Pipe Sleeves: Fabricate from galvanized sheet-metal, closed with lock-seam joints.

1. For following pipe sizes, provide gauge indicated:
   a. Three Inch Pipe and Smaller: 20 gauge
   b. Four Inch to Six Inch Pipe: 16 gauge

PART 3 - EXECUTION

3.1 INSPECTION

A. Contractor shall examine location where these specialties are to be installed and determine space conditions and notify Architect in writing of conditions detrimental to proper and timely completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install HVAC Specialties where shown, in accordance with manufacturer's written instructions and with recognized industry practices, to ensure that HVAC Specialties comply with requirements and serve intended purposes.

B. Coordinate with other work as necessary to interface installation of HVAC Specialties with other components of systems.

C. All coils and heat exchangers shall be equipped to measure and adjust flow. Adjustable valves with flow measuring taps are preferred. The balancing valve shall not be used for coil isolation--provide ball or butterfly isolation valves in addition to the balancing valves.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of HVAC Specialties, test HVAC Specialties to demonstrate compliance with requirements. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.4 PIPE INSTALLATION

A. Install horizontal piping level (except drain piping and as otherwise noted) and parallel to building construction. All vertical piping to be plumb.

B. Make any changes in direction with fittings, do not kink or bend piping. Elbows are to be long radius type wherever possible.

C. Regardless of how shown on schematic piping diagrams, do not install a tee so that flow enters from opposite directions.

D. Do not rearrange piping in a manner to increase pressure drop without written approval from Architect/Engineer.

E. Install drains with cap and brass hose connector at all low points and traps of the system.

F. Vent piping from the high temperature hot water system shall comply with all requirements of high temperature hot water piping specified herein before. This shall also apply for the high temperature water safety valve discharge piping.

G. General:

1. Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure.
2. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly, maintenance or replacement of valves and equipment.
3. Reduce sizes by use of reducing fittings.
4. Install piping without springing or forcing.
5. Provide sufficient swing joints, anchors, expansion loops and devices necessary to permit free expansion and contraction without causing undue stresses.
6. Support piping independently at equipment so its weight will not be supported by the equipment.
7. Support piping to maintain a consistent slope as indicated on the drawings without sagging or pocketing of any kind. Where not otherwise indicated, all horizontal piping shall slope a minimum of 1/16 inch per foot to drain at system low points.
8. Provide air vents at high points of all pumped piping systems. Provide drains at all low points and traps.
9. Install horizontal piping parallel to building construction, make any changes in direction with fittings.

H. Location:

1. Locate piping runs, except as otherwise indicated, both vertically and horizontally to allow for complete drainage of piping system (pitched to drain).
   a. Avoid diagonal runs wherever possible.

b. Orient horizontal runs parallel with walls and column lines.

2. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of the building.
   a. Limit clearance to 0.5” where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any.
   b. Where possible, locate insulated piping for 1.0” clearance outside insulation.
3. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction or above suspended ceilings.
   a. Do not encase horizontal runs in solid partitions, except as otherwise indicated.

I. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures.

1. Exception: where shown on drawings or where accepted by the Engineer, provide drip pan under piping, and conform to NEC.
2. In no case shall piping run directly above transformers, electrical panels or switchgear.

J. Unless otherwise specified, all flanged joints shall be fitted with Manville or equal ring gaskets designed for the intended service.

K. Coordinate with other work as necessary to interface installation of piping with other components of systems.

L. Provide and erect in a workmanlike manner, according to the best practices of the trade, all piping shown on the Drawings or required to complete the installation intended by these Specifications.

M. All piping taps shall be from the top of the pipe unless approved by the Engineer.

N. The Drawings indicate schematically the size and location of piping. Piping shall be set up and down and offset to meet field conditions and to provide adequate maintenance room and headroom in the Mechanical Rooms.

O. Study the General Construction Specifications and Plans, of the exact dimension of finished work and of the height of finished ceilings in all rooms where radiation, units, equipment or pipes are to be placed and arrange the work in accordance with the Schedule of Interior Finishes, as indicated on the Architectural Drawings.

P. All exposed piping shall be run perpendicular and/or parallel to floors, interior walls, etc. Piping and valves shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance. All valves, controls and accessories concealed in furred spaces and requiring access for operation and maintenance shall be arranged to assure the use of a minimum number of access doors.

Q. All pipe lines made with screwed fittings must be provided with a sufficient number of flanges or unions to make possible any taking down of the pipes without breakage of fittings.

R. All piping shall be erected as to insure a perfect and noiseless circulation throughout the system. No bull head tees will be permitted.

S. All valves and specialties shall be so placed as to permit easy operation and access.

T. Provide proper provision for expansion and contraction in all portions of pipework, to prevent undue strains on piping or apparatus connected therewith. Provide double swings at riser transfers and other offsets wherever possible, to take up expansion. Arrange riser branches to take up motion of riser.

U. Approved bolted, gasketed, flanges (screwed or welded) shall be installed at all apparatus and appurtenances, and wherever else required to permit easy connection and disconnection. Screwed unions shall be used on piping 2 ½ " or less.

V. All piping connections to coils and equipment shall be made with offsets provided with screwed or welded bolted flanges so arranged that the equipment can be serviced or removed without dismantling the piping.

W. If, after plant is in operation, any coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be repiped with approved and necessary fittings, air vents, or vacuum breakers at no extra cost. If connections are concealed in furring, floors, or ceilings, bear all expenses of tearing up and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

X. Fittings shall be of the eccentric reducing type, where changes of size occur in horizontal piping to provide for a proper drainage or venting. Steel pipe bends shall be made of the very best grade open hearth, low carbon steel, leaving uniform exterior and interior surface. Pipe bends shall be made with seamless steel pipe, having a minimum radius of not less than five (5) pipe diameters.

Y. Tubing shall be erected neatly in a workmanlike manner. Bends in soft copper tubing shall be made by benders to prevent deformation of the tubing in the bends. Approved seat-to-pipe threaded adapters shall be provided for junctions with valves and other equipment having threaded connections.

Z. Vertical sections of main risers shall be constructed of pipe lengths welded together. No couplings shall be used.

AA. The ends of all pipe and nipples shall be thoroughly reamed to the full inside diameter of the pipe and all burrs formed in the cutting of the pipe shall be removed.

BB. Piping shall be installed in accordance with the latest edition of the ASME Code for Pressure Piping.

CC. All piping shall be concealed above furred ceilings in rooms where such ceilings are provided (except where specifically indicated otherwise on the drawings, or in walls or partitions, except as otherwise indicated).

DD. Piping at all equipment and control valves shall be supported to prevent strains or distortions in the connected equipment and control valves. Piping shall be supported to allow for removal of equipment, valves and accessories with a minimum of dismantling and without requiring additional supports after these items are removed.

EE. Pipe nipples - Any piece of pipe 3" in length and less shall be considered a nipple. All nipples shall be extra heavy. Only shoulder nipples shall be used. No close nipples will be permitted.

FF. Screw threads shall be cut clean and true; screw joints made tight without caulking. No caulking will be permitted. A non-hardening lubricant shall be used. No bushings shall be used. Reductions, otherwise causing objectionable water or air pockets, to be made with eccentric reducers or eccentric fittings.

GG. Provide vents with hose connector and cap at all high points.

3.5 WELDING

A. Before any operator shall perform any pipe welding, also submit the operator's qualification record in conformance with provisions of the code having jurisdiction, showing that the operator was tested and certified under the Procedure Specification as before mentioned.

B. Welding:

1. Conform to the latest revision of the applicable code, whether it is the ASME Boiler and Pressure Vessel Code, Code for Pressure Piping ANSI B31, or such state or local requirements as may supercede codes mentioned above.
2. All pipe welding operators shall comply with the requirements of the American Welding Society.
3. Machine cut and bevel piping ends for v-type joints.
4. Use recommended bevels and spacing between ends of pipe to assure full penetration complete to inside diameter of pipe.

C. Welded Joints:

1. Will be observed visually by the Architect/Engineer.
2. Any weld judged defective from a visual observation, shall be ordered tested at the expense of the Contractor or chipped out for full depth and re-welded.
3. Welded joints shall be x-rayed at a frequency determined by ASME codes. Welds that prove deficient shall be chipped out to full depth and replaced.

D. Welding Fittings:

1. Unless otherwise noted, make all changes in direction and branch take offs with manufactured fittings.
   a. Use long radius (R=1.50) fittings wherever possible.

2. Shop Fabricated Fittings:
   a. Branches more than two pipe sizes smaller than main line may be made with "weld-o-let" type pre-manufactured saddle fittings.
   b. Where specifically allowed by the Engineer, angles of less than 22½º and branch piping from headers may be made by shop fabricated or manufactured metered fittings.
   c. Submit shop drawings.
   d. Thoroughly clean fittings to remove slag.
   e. Fittings shall be available for observation by the engineer prior to installation.
3. In no case will field made miters or weld-o-let fittings be allowed. Exception: Temperature control wells and water treatment taps may be made with weld-o-let fittings in pipe 3" or larger in diameter.

E. Installation

1. Weld ells shall have a center line radius not less than diameter of the pipes.
2. Instrumentation connections 3/4" and smaller on all systems shall be provided by welding threaded 2000# forged steel half couplings to the pipe.
3. All pipe to be welded shall be cut off clean and beveled. All welding shot shall be removed.
4. Composition of welding electrodes shall be in accordance with manufacturer's recommendations.
5. Assume responsibility for the quality of welding done and repair or replace any work not in accordance with these specifications.
6. Cut weld test plugs at locations selected at random by the Architect. The test plugs shall be tested by the testing agency approved for this project. Failure of the test plugs to meet the standards of the specified codes and agencies shall result in the complete removal and replacement of the joint and retesting of the operator who performed the welding. The removal and replacement of the joints shall be at no additional cost to the Owner.

3.6 COPPER TUBING JOINTS AND FITTINGS

A. Unless otherwise noted, make all couplings, changes in direction, branch outlets, and transitions to other materials or joining methods with standard manufactured fittings.

B. Do not expand or swage piping in lieu of proper solder fittings.

C. Do not extrude or “pull” branch outlets with “tee-drill” type equipment.

D. Do not use self tapping type branch outlets.

1. See “hot taps” below.

3.7 THREADED JOINTS AND FITTINGS

A. All threaded joints shall be made in accordance with American National Standard B2.1.

1. Do not overthread pipe.
2. Apply pipe joint compound on male threads only.
3. Do not use right and left hand threaded joints to make a “union”.

B. Do not thread steel pipe schedule 10 or lighter.

1. UL listed light wall pipe may be threaded in accordance with its listing.

C. Screwed Piping

1. All connections to apparatus with screwed piping shall be made with 250 pound brass seat unions.
2. All screwed nipples shall be Schedule 80 nipples.

3.8 EQUIPMENT CONNECTIONS

A. Do not allow weight of piping or expansion of piping to put stress on equipment connections.

B. Pipe equipment to allow for servicing (coil pull, tube pull, etc.) with minimum of disruption to piping.

C. Provide unions or flanges at all equipment connections.

3.9 FREEZE PROTECTION

A. Fill systems with indicated solution by volume of propylene glycol and water.

B. Pre-mix all solutions before injection into system.

3.10 AIR VENTS

A. Install automatic air vents at high points.

B. In installing water piping systems and all equipment, carefully plan the actual installation in such a manner that high points and air pockets are kept to a minimum and are properly vented where they are unavoidable. All air elimination devices called for on the Drawings and in these Specifications shall be provided and properly installed. In addition, furnish and install all other air elimination devices which may be required due to job conditions. Assume responsibility for a proper, continuous and automatic air elimination to assure even and balanced distribution of water to all equipment.

3.11 RELIEF VALVES

A. Install pressure relief valves on all vessels, which may be isolated from other relief valves by closing valves. Pipe discharge full size to nearest floor drain.

3.12 PRESSURE TEMPERATURE TAPS

A. In Pipes 2” and Smaller: Install taps in tee at change in direction so inserted thermometer stem will be parallel to center line of pipe.

1. Add extra change in direction if necessary.
2. Allow clearance for insertion of thermometer.
3. Insure that gauge or thermometer will be in a readable position.

B. Furnish and install in each supply and return runout to each reheat coil and where indicated on the Drawings, a 1/4" MPT fitting to receive either a temperature or pressure probe 1/8" OD. Fitting shall be solid brass with valve core of Nordel (Max. 275˚F), fitted with a color coded and marked cap with gasket, and shall be rated at 1000 psig.

C. In addition, the installing contractor shall supply the Owner with six pressure gauge adapters with 1/8" OD probe and 6 five inch stem pocket testing thermometers; 25-125˚F for chilled water and six 50-500˚F for hot water.

D. Provide one pressure and temperature test kit consisting of one 0-60 PSI, water pressure gauge and one 0-30 psi water pressure gauge each with no. 500 gauge adapter attached, a 25-120˚F

pocket testing thermometer, a 0.220 F. pocket test thermometer, a No. 500 gauge adapter, and a protective carrying case. Provide one additional 0-60 psi pressure gauge and one additional 0 - 30 psi pressure gauge.

E. Test kit shall be used by the Balancing Contractor to balance the systems and then it shall be turned over to the Owner.

F. Test stations and test kit shall be manufactured by Paterson Engineering Company, Inc. or approved equal.

3.13 HOT TAPS

A. Installing a branch line in piping while under service or static pressure (hot taps) shall only be done where specifically authorized

B. Submit the proposed method of procedure for each fluid service and pipe material.

1. Hot tap procedure shall remove a plug of main tap material and retrieve it. The plug shall be a maximum of 1 pipe size smaller than the branch size. Hang the removed plug by a chain at the completed tap.
2. Hot tap procedure shall not affect the temperature or pressure rating of the piping system.
3. Hot tap procedure shall be done through a gate or ball valve.

3.14 CLEANING

A. All piping systems shall be thoroughly flushed out with the approved cleaning chemicals to remove pipe dope, slushing compounds, cutting oils, and other loose extraneous materials. This also includes any piping systems which are not listed as requiring water treatment.

B. Develop plan for flushing and cleaning piping. Submit plan for approval prior to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.

C. Prior to flushing, temporarily isolate or bypass dirt sensitive equipment and devices, including the following:

1. Automatic flow control valves
2. Heating and cooling coils
3. Convetors
4. VR System
5. Flow measuring devices

A full size bypass pipe with shut-off valve shall be installed at each piece of hydronic equipment, as noted above, and at the end of risers serving fan coil units and fin tube radiation.

D. Prior to flushing, install fine mesh construction strainers at inlet to all equipment with connections 2-1/2” and larger. Install fine mesh construction element in permanent strainers. During flushing and cleaning, remove and clean strainers periodically. At completion of final flush, clean permanent strainers, remove construction strainers.

E. Circulate flush water and clean strainers prior to installing cleaning chemicals. Following flushing, install cleaning chemicals and circulate through the entire system for a minimum of one hour, or as directed chemical supplier. Take water sample for owner's use. Drain system, including all low points. Flush, drain and fill system, circulate for one hour, sample for owner's use. Drain, flush, fill, circulate and sample until system is free of cleaning chemicals, as indicated by analysis of samples.

F. Clean all water piping and chiller tubes as follows:

1. All new equipment and piping needs to be pre-cleaned to remove the oils of manufacture prior to equipment start-up.
2. The cleaning of new systems is accomplished with an alkaline phosphate cleaner supplied by the water treatment supplier. Coordinate with the Chemical Water Treatment section of this specification.
3. Upon completion of a system cleaning, the system should be flushed until the ortho phosphate is within 1 PPM of City Water. If the flushing occurs over an extended period of time (more than 24 hours) the flush water shall be treated water.
4. The system should then be immediately sterilized and treated. Systems containing copper should boost azole levels to 20 PPM.
5. Systems that contain piping that cannot be isolated for alkaline phosphate cleaning must be cleaned by adding a surfactant for 48 hours to the system. This will help remove the oils of manufacture.
6. New chillers require the following cleaning:
    a. Remove both heads
    b. Punch tubes with reversible tube brushing machine with "Christmas Tree Brushes" and appropriate torque setting for specific tube size. Brushes shall be changed every 5-10 tubes.
    c. Inject alkaline phosphate cleaner into each tube during punching to remove oils of manufacture.
    d. Inspect a minimum of three cleaned tubes with boroscope to confirm removal of all oils. A minimum of one hot, one high flow, and one low flow tube must be inspected.
    e. Tubes shall not be left open to atmosphere for more than one week after exposure to water.
    f. Upon flooding of tubes, azole levels shall be bumped to 20 PPM to insure re-passivation of the copper.

G. After flushing, contractor shall remove all temporary strainers and hang on strainer bodies for inspection.

H. Chemical cleaning and flush water shall be circulated at a minimum velocity of 6 feet per second. Contractors are responsible to supply temporary pumps as required for circulation of water at requisite velocities. Use of system pumps for circulation of cleaning and flush water, where available, is acceptable.

I. The chemical supplier shall verify that all chemicals utilized during cleaning are compatible with the materials in the systems. The chemical supplier shall instruct as to the proper feed rates, shall check that the cleaning solution is actually in each system, shall instruct the contractor as to when to flush the system and shall check each system following flush to insure all cleaning chemicals have been removed from each system.

J. A certificate of cleaning shall be submitted by the cleaning chemical supplier to the Owner's representative.

3.15 CORROSION PROTECTION

A. Provide dielectric unions at unions between piping of different materials.

B. See water treatment program requirement elsewhere in this specification.

C. All components of system shall be compatible with propylene glycol and water solution.

D. At no time should water be introduced to a system without inhibitor being added.

E. Vapor phase inhibitor shall be used in any case where a system will be drained down prior to turnover.

3.16 PRESSURE GAUGES

A. Pressure/temperature test ports shall be provided on each coil bank, heat exchanger, fan coil, and at all permanent pressure gauge locations. Use extended body style to allow for insulation thickness. Seals shall be appropriate for operating water temperature and pressure as follows.

1. Hot Water, Glycol - Nordel Seat
2. Cold Water, Chilled Water - Neoprene Seat

B. Pump assemblies: Use a single gauge with multiple taps to pumped system (strainer inlet, strainer outlet, pump suction and pump discharge) per the detail on the drawings.

C. Allow clearance for removal of gauge.

D. Insure that gauge will be in a readable position.

E. Furnish and install where indicated on the Drawings and where specified herein.

F. All gauges shall be installed so as to be easily readable from the floor. Where conditions are such that gauges on piping would not be readable from the floor, the gauges shall be installed on panelboards.

G. Panel mounted gauges shall be designed for flush mounting with back connections and shall be provided with an engraved nameplate mounted below each gauge to identify its service. The nameplates shall be chrome plated with black filled letters.

H. Differential pressure switches, pressure sensing pipe taps, furnished by temperature control manufacturers shall be installed under this Section.

I. All gauges on water lines shall be fitted with filter type pressure snubbers consisting of 3/8" dia. x 1/8" thick, micro metallic stainless steel filter, as manufactured by Operating and Maintenance Specialties or approved equal. All gauges on steam lines shall be fitted with pigtails.

J. A pressure gauge shall be installed in the suction and discharge of each hot water, chilled water and condenser water pump. A pressure gauge shall be installed in the chilled water and condenser water inlet and outlet of each refrigerating machine. A pressure gauge shall be

installed in the inlet and outlet of each heat exchanger and coil. Additional pressure gauges shall be installed where indicated on the Drawings.

K. On devices such as pumps, strainers, coils, etc., where the differential pressure is the desired information, install only one pressure gauge with valved connections to the upstream and downstream pressure taps. Include a P/T test port in addition to the pressure gauge. Provide a second set of isolating valves at the gauge if gauge location is not within reach of tap points.

3.17 THERMOMETERS

A. Furnish and install, where indicated on the Drawings and where specified herein, thermometers as manufactured by American Trerice, Weksler, Weiss or approved equal.

B. All thermometers shall be installed in such a manner as to cause a minimum of restriction to flow in the pipes and so that they can easily be read from the floor.

C. All instrument wells for controls and indicators furnished by the temperature control manufacturer shall be installed under this Section.

D. Where conditions are such that thermometers would not be readable from the floor, remote bulb dial thermometers shall be mounted on panelboards. The thermometers shall be 5 inch dials and shall be vapor actuated. The thermometers shall have separable wells. Panel mounted thermometers shall be provided with an engraved nameplate mounted below each thermometer to identify its service. The nameplate shall be chrome plated with black filled letters.

E. A thermometer shall be installed in the hot water inlet and outlet of each heat exchanger and coil. A thermometer shall be installed in the chilled water and condenser water inlet and outlet of each refrigerator machine. Additional thermometers shall be installed where indicated on the Drawings.

3.18 MACHINERY GUARDS

A. Moving parts of machinery exposed to contact by personnel shall be guarded by barrier to a type which complies with OSHA Code.

B. Exposed moving parts such as belts and couplings shall have not less than 3/4" No. 16 gauge metal guards with all edges rounded an gauge, material and construction shall be in accordance with OSHA standards - paragraphs 7173.3, 7173.5 and 7174.1. Guards shall have 1-1/4" x 1-1/4" x 1/8" angle iron frame properly supported.

C. All machinery guards covering the ends of motor or equipment shafts shall have openings for the insertion of a tachometer. Machinery guards shall be painted with two coast of machinery gray enamel.

3.19 EXPANSION TANKS

A. Expansion tanks shall be welded, and of the size as indicated on the Drawings. Tanks shall be galvanized after fabrication. Tanks shall be steel with dished heads and equipped with connections for fill, drain and system connections. Water column and connections shall be furnished. Tanks shall be constructed in accordance with ASME Code for Unfired Pressure Vessels and so stamped.

B. Tanks shall be provided with gauge glasses for full height, and for closed tanks provide combination air charger and tank drainer. Gauge glasses shall have protective shield.

C. Furnish and install as shown on the Drawings, EX-TROL Pressurized Diaphragm Type Expansion Tanks as manufactured by AMTROL INC. It shall be air precharged to the initial fill pressure of the system. It shall be suitable for a maximum working pressure in excess of anticipated system pressure at maximum operating temperature and shall be furnished with ASME stamp and certification papers. It shall have a sealed-in elastomer diaphragm suitable for an operating temperature of 240°F. Horizontal tanks to be furnished with saddles for horizontal installation where applicable.

3.20 BALL JOINTS, LOOPS, ANCHORS AND GUIDES

A. Provisions for expansion in piping mains, branches, and risers shall be made by the installation of offsets, expansion loops, or compensators as indicated on the Drawings or as required by these specifications. Every 100'-0" horizontal steam and hot water piping shall have expansion loop and anchors. Minimum loop shall be 8'-0" by 6'-0" if not indicated on the Drawings.

B. All piping with loops or compensators shall be anchored so as to throw all expansion toward the loops or compensators.

C. Guides shall be installed on both sides of each expansion loop and compensator. Guides shall be Flexonics pipe alignment guides or approved equal. Anchors and guides shall be secured to beams, columns or concrete slabs.

D. Pipe hangers and rollers are not considered guides.

E. Provide 12" long guides for each expansion joint. Guides shall be located 3'-0" on each side of the expansion joints.

F. Copper piping: Furnish and install as shown on plans, or where necessary to absorb max. 1-3/4" expansion and max. 1/4" contraction between two anchor points in copper lines, up to and including 2-1/2", Flexonics Model HB Expansion Compensators having two-ply phosphor bronze bellows and brass shrouds and end fittings, as manufactured by Flexonics Division of Calumet and Heela, Inc., Bartlett, Illinois. All internal parts shall be of non-ferrous metals. Service pressure shall be external to the bellows. Compensators shall have internal guide extending the full length of the bellows travel. Compensators shall have internal positive anti-torque devices to prevent twist or torque on installation and shall have properly located positioning clip to insure installation of correct end-to-end dimension to allow full rated traverse. Compensator shall be for max. 125 psig. working pressure. Test pressure shall not exceed 175 psig.

G. Steel Piping: Furnish and install as shown on plans, or where necessary to absorb max. 1-3/4" expansion and max. 1/4" contraction between two anchor points in iron and steel pipe lines up to and including 2-1/2", Flexonics Model II Expansion Compensators having two-ply stainless steel bellows and carbon steel shrouds and end fittings, as manufactured by Flexonics Division of Calumet & Heela, Inc., Bartlett, Illinois. Service pressure shall be external to the bellows. Compensators shall have properly located positioning clip to insure installation at correct end-to-end dimension to allow full rated traverse. Compensator shall be for Max. 150 psig. working pressure. Test pressure shall not exceed 200 psig.

H. Manufacturer shall note on all submittal forms the resultant anchor loads due to pressure thrust and compressive forces at design conditions. Expansion joints shall be as manufactured by ADSCO, Zallea, Flexonic, or approved equal.

L. Provide expansion loops in grooved piping systems consisting of (8) Victaulic flexible couplings, (4) 90 degree elbows, and (3) grooved end pipe spools provided in water systems up to 250 deg F in accordance with Victaulic recommendations for expansion compensation. Install in-line expansion joints in spaces where loops or bends cannot be applied. Victaulic Style 150 Mover expansion joint, 2" through 6" sizes, shall be packless, gasketed, slip-type expansion joint with grooved end telescoping body for installation with rigid couplings providing up to 3" axial end movement, designed for working pressures up to 350 psi. Victaulic Style 155 expansion joint ¾" and larger sizes shall be a combination of grooved end short nipples and flexible couplings joined in tandem to provide increased expansion. Joint movement and expansion capabilities determined by number of couplings/nipples used in the joint. Pressure rating dependent on size and style of flexible couplings used.

3.21 AUTOMATIC FLOW-CONTROL VALVES
induction units and fan coil units. Check physical dimensions to fit into units.
[Note to Spec Writer: Use where balancing of system is very important for heat pump Edit]

A. The Contractor shall provide and install for each heat pump and fan coil unit, one "Autoflow" model FVT or Griswold compact pressure compensating flow control valves in one piece configuration consisting of ground joint union and flow control valve and Petes plugs. Petes plugs shall be provided on both sides of condenser flow heat pumps only.

B. All valves are to be factory set to control the flow rate within 4% of the selected rating over an operating pressure differential of at least ten times the minimum required for full flow conditions.

C. The valves shall be all metal with threaded or seat connections. Metallurgy shall be all brass and stainless steel.

D. Performance certification of valves by an independent laboratory shall be furnished.

E. All valves shall have unions to allow field-exchange of internal components without removing the valve body from the pipeline.

F. All valves shall be permanently marked to show direction of flow and flow rates.

3.22 STRAINERS FOR WATER SYSTEM

A. Furnish and install a full size Y-pattern strainer on the inlet of each control valve at each water pump and where indicated on the Drawings.

B. An approved blow-out connection with gate valve shall be made to each strainer. The valves shall be located not higher than 8 feet above the floors. All drain connections shall be piped to floor drains.

3.23 FLANGES FOR ORIFICE PLATES

A. The automatic control manufacturer shall furnish orifice plates for high temperature hot water lines as specified in the article of this Section entitled "Automatic Controls".

B. Install the orifice plates and furnish and install the companion flanges.

C. The orifice plates shall be installed in strict accordance with the manufacturer's recommendations.

D. Straightening vanes shall be installed if required by the automatic control manufacturer.

3.24 MECHANICAL PIPE COUPLINGS

A. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or graphite paste as recommended by vendor, to facilitate installation.

B. Pipe grooving shall be in accordance with the manufacturer's specifications.

C. Pipes, fitting, and valve shall be provided with grooved or shouldered ends in accordance with pipe coupling manufacturer's latest published literature. Flanged or threaded end valves may be used with grooved adapters.

D. Couplings and fitting shall be designed for a system pressure specified elsewhere and in conformance with manufacturer's published data.

E. Entire coupling installation shall be done in accordance with manufacturer's latest published literature.

F. After completion of pipe coupling installation, Contractor shall furnish to the Owner's representative a signed certificate of compliance with the manufacturer's installation instructions.

G. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by coupling manufacturer.

H. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing.

I. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

J. All changes in direction shall be made with radius type elbows.

1. Use long radius (R=1.5D) fittings wherever possible.
2. Angles less than 22½º may be made with pre-manufactured metered fittings.
3. Use of the angular deflection capabilities of grooved pipe couplings for intentional changes of direction shall not be allowed.

K. All branch outlets shall be made with pre-manufactured 3-way fittings.

1. Shop fabricated Weld-o-let style welded saddle fittings may be used for branches more than two pipe sizes smaller than the main.

2. Mechanical saddle tap fittings shall not be allowed.

L. Pipe shall be adequately laterally supported to prevent “pipe squirm”. Provide a minimum of one hanger per pipe section. No pipe section shall be left unsupported between any two couplings.

1. Rigid type couplings may be considered equivalent to welded or soldered pipe for the above requirements.

M. Risers more than 20’ high shall be made with rigid type couplings.

N. Flexible couplings may be provide on the inlet and outlet of each piece of mechanical equipment. Flexible couplings used to control vibration and thermal expansion/contraction compensation.

1. Provide a flexible Use a minimum of flexible coupling for every union feet for DX chilled water piping.
2. The above is for cut grooved pipe. Double the amount of the connectors with roll grooved pipe and fittings.

3.25 FLOW MEASURING DEVICES

A. Provide complete Venturi flow measuring system as manufactured by Barco Division, Aeroquip Corp., or approved equal.

B. Upstream pipe diameters of straight pipe shall be five (5) minimum and downstream pipe diameters shall be two (2) minimum as recommended by manufacturer.

C. For location of Venturi flow stations refer to the Drawings.

3.26 PIPE SLEEVES

A. Install pipe sleeves where piping passes through walls, floors, ceilings, roofs and structural members, except soil pipe penetrations through concrete slab on grade.

B. Where possible pour sleeve in place or grout.

C. Provide sleeves of adequate size, accurately centered on pipe runs, so that piping and insulation (if any) will have free movement in the sleeve in non-fire rated penetrations.

D. In fire rated penetrations, size sleeves such that the resulting annular space is in accordance with the application requirements of the fire stopping system. All above grade floor penetrations shall be considered to be fire-rated.

E. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25” above floor finish and, where floor surface drains to a floor drain, extend floor sleeve 0.75” above floor finish.

F. Provide temporary support of sleeves during placement of concrete and other work around sleeves.

G. Provide temporary closure to prevent concrete and other materials from entering pipe sleeves.

H. Except as otherwise indicated, install steel pipe sleeves.

I. At interior partitions and ceiling, install sheet metal sleeves.

J. At exterior penetrations below grade, install iron pipe sleeves.

K. Seal exterior sleeve penetrations at grade weather tight.

L. Caulking:

1. Where water seal or sound seal, but not fire seal, is needed, (foundation walls, slab on grade): fiberglass backing and heavy bead of silicone caulking compound.
2. Where sleeve pierces a fire separation: Fire stop material in accordance with manufacturer's directions and UL listing.

M. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior, and elsewhere as indicated.

N. Compensators: Install where shown or where required because piping arrangement does not provide sufficient flexibility.

1. Protect compensators from over-travel and over-stress during remaining installation and testing.

O. Flexible Connectors: Install at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

P. Guides: Install where shown and where required in accordance with expansion compensators published requirements. As a minimum, install one guide within four pipe diameters of compensator, and one guide 14 pipe diameters from first guide.

3.27 TEST

A. Hydronic piping systems other than ground source heat pump loop shall be hydrostatically tested at one and one half times the system design operating pressure unless a higher pressure is required elsewhere, but not less than 100 psi. The duration of each test shall be not less than 4 hours.

B. See additional requirements elsewhere in this specification.

END OF SECTION 232113

SECTION 232213 - STEAM AND CONDENSATE PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's data for the following:

1. Steam traps
2. Strainers
3. Vacuum breakers

PART 2 - PRODUCTS

2.1 PIPING

A. Provide products complying with ANSI B31.1 for Power Piping.

Piping Types and Materials

Service & Location	Pipe Size	Pipe Material & Weight	Joint Type	Fitting Material
Low Pressure Steam (15 psig or less)				
Inside Building	2" or smaller	Steel, Schedule 40, ASTM A53, Type S, Grade B (Schedule 80 within 20' of PRV station)	Threaded or Welded	Cast Iron or Steel
	2-1/2" or larger	Steel, Schedule 40, ASTM A53, Type S, Grade B (Schedule 80 within 20' of PRV station)	Welded	Steel
Outside Building	2" or smaller	Steel, Schedule 40, ASTM A53, Type S, Grade B	Threaded or Welded	Cast Iron or Steel
Low Pressure Steam Condensate (15 psig or less)				
Inside Building	2" or smaller	Steel, Schedule 80, ASTM A53, Type S, Grade B	Threaded or Welded	Cast Iron or Steel
	2-1/2" or larger	Steel, Schedule 80, ASTM A53, Type S, Grade B	Welded	Steel
Outside Building	2" or smaller	Steel, Schedule 80, ASTM A53, Type S, Grade B	Threaded or Welded	Cast Iron or Steel

B. Vents (steam safety and relief): 2½" and below: Steel, Schedule 80; 2" and below: C.I., 125#, screwed welding.

2.2 STEAM TRAPS

A. Manufacturers:

1. Design Basis: Armstrong
2. Other Acceptable Manufacturers:
   a. AAF
   b. Dunham-Bush
   c. Hoffman
   d. Sarco
   e. Trane

B. Capacity: Continuous flow capacity of twice the maximum equipment condensing rate.

C. Connection Size: ¾ inch, minimum.

D. Access to Internal Parts: Without disturbing piping connections.

E. Valve and Seat: Heat-treated.
1. Stainless steel.
2. Chrome steel.

F. Float and Thermostatic:

1. Model: Series B.
2. Body: Cast iron or semi-steel.
3. Float: Stainless steel.
4. Ratings: SHEMA.
   Combination float and thermostatic traps shall have a valve mechanism, the position of which is controlled by a closed, stainless steel ball float. The seat of the valve will be watertight at all times. The action of this type of trap must be gradual and modulating, it must discharge the condensate as soon as it enters the trap and its rate of discharge must be proportionate to the rate of the flow of condensate to the trap.

   The traps shall be provided with an automatic, thermostatic air bypass of the balanced pressure, multiple bellows type or disc diaphragm.

   All exterior combination float and thermostatic traps shall be supplied with a liquid expansion trap valve connected to the drain port of the trap, similar to Spirax Sarco by drain.

   All working parts shall be of non-corrosive metal (hard bronze, monel or stainless steel) and shall be removable without disconnecting the piping. Floats shall be of stainless steel.

   Body and cover shall be of high grade cast iron suitable for 125 psi pressure for the 0-15 psi line.

G. Inverted Bucket:

1. Model: Series 800.
2. Body: Cast Iron.
3. Bucket: Stainless steel.
4. Inverted bucket traps for pressures from 1 to 250 psig, shall have semi-steel body. Valve and valve mechanism are to be of stainless steel. Up to 75 psi traps shall have 125 psi rating. Above 75 psi the rating shall be 250 psi.

   Inverted bucket shall be of stainless steel.

   All exterior combination float and thermostatic traps shall be supplied with a liquid expansion trap valve connected to the drain port of the trap, similar to Spirax Sarco bydrain.

   Traps shall have bi-metallic vent. All traps shall be equipped with built-in removable strainer. Same is to be of perforated sheet brass or stainless steel.

SIZE	WITH BIMETAL AIR VENT
1/2" or 3/4"	B12-X
3/4"	B22
1"	B32
1-1/4"	B42
2"	B52

H. Thermostatic:

1. Model: Dunham-Bush 1E or 2E.
2. Body: Cast brass.
3. Thermostatic traps shall be of the corrugated-bellows, balanced pressure type, with a bellows made of high grade red brass or phosphor bronze. Regardless of working pressure traps shall have a minimum working pressure of 125 psi. All steam traps to be sized on condensate at steam temperature.

   The bellows shall be either of Phosphor Bronze (with high temperature solder and brass sleeve protection) or Monel metal, properly brazed.

   Low pressure (0-15 psi) and medium pressure (15-65 psi) thermostatic traps shall have castbrass or forged brass bodies suitable for 125 psi pressure and shall be provided with a union connection at the inlet. Self-aligning valve heads and seats for the low pressure traps shall be of a suitable, non-corrosive material. Seats shall be removable.

2.3 STRAINERS

A. Manufacturers:

1. Design Basis: Armstrong
2. Other Acceptable Manufacturers:
   a. AAF

b. Hoffman
c. Mueller
d. Sarco
e. Trane

B. Body: Cast Iron or bronze.

C. Removable Screen:

1. Material: Stainless steel.
2. Net Free Area: Four times pipe area.
3. Perforations:
   a. Size 2” and Smaller: 1/32 inch.
   b. Size 2-½” and Larger: 1/16 inch.

D. Blow-down Valve: Provide valve for strainers 2-½” and larger.

E. All strainers in steam lines, shall be Y-pattern, set in a horizontal (or vertical downward) run of the pipe. Where this is not feasible, strainers may be of enlarged-cross-section type. Strainers shall be so arranged as not to "trap" pipes, and to facilitate disconnection and opening-up for cleaning. Unless otherwise indicated, strainers shall be line size.

F. Strainer screen perforations shall be 1/32" for steam and mixture of steam and condensate. Strainers of the "Y" type similar to Sarco Bulletin 1220 type IF and AF or approved equal.

G. All strainers shall be provided with flanged covers for screen removal in lieu of screwed covers wherever obtainable.

H. All strainer screens 8" and above shall be reinforced for the operating conditions.

2.4 GASKETS (<400 PSI & 475 F)

A. All gaskets shall be compatible with operating pressure, temperatures, and all components of the system.

B. Manufacturers:

1. Design Basis: Garlock HTC-9800
2. Other Acceptable Manufacturers:
   a. Flexitallic

C. Gasket Material Requirements:

1. Contain no asbestos.
2. Be comprised of carbon fibers bound with synthetic rubber.
3. Be thoroughly and evenly mixed and compressed into a sheet having compact and uniform texture, either cross laminated or single ply with a finished thickness of ±10%.
4. Have a minimum density of 105 lb/ft^3
5. Be distinctively marked so that the manufacturer of pre-formed gaskets or gaskets cut from the standard sheet can be readily identified.
6. Manufacturer shall guarantee a shelf life of at least 3 years from date of manufacture.

D. Gasket Dimensions:

1. Dimensions of all gaskets used by Steam Distribution Field Operations must be in compliance with the ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges. See table below for sizes.

Pipe Size (in)	Gasket I.D. (in)	Gasket O.D. (in)
1	1-5/16	2-7/8
2	2-3/8	4-3/8
3	3-1/2	5-7/8

E. Material Testing:

1. Seal ability properties, determined in accordance with Method B of ASTM F37-00, "Standard Test Methods for Sealability of Gasket Materials", as follows:
   a. A maximum leakage of 0.1 milliliters per hour when tested using ASTM Fuel A under a pressure of 9.8 psig as the test fluid and a flange load of 500 psi on the gasket specimen.
   b. A maximum of 0.1 milliliters per hour when tested with nitrogen under a pressure of 30 psig as the test fluid and a flange load of 3,000 psi on the gasket specimen.
2. An average compressibility not exceeding 17 percent and an average minimum recovery of 55 percent when tested in accordance with Procedure A of ASTM F36-99 (2003), "Standard Test Method for Compressibility and Recovery of Gasket Material".
3. An average minimum tensile strength of 1,500 pounds per square inch measured across the grain and 4,500 pounds per square inch measured with the grain when tested in accordance with Procedure A of ASTM F152-95 (2002), "Standard Test Methods of Tension Testing of Nonmetallic Gasket Materials".
4. An average maximum creep relaxation of 15 percent when tested with 3,000 pounds per square inch initial load in accordance with Method B of ASTM F38- 00, "Standard Test Methods for Creep Relaxation of a Gasket Material".
5. An average maximum adhesion force of 200 lb and not exhibit any tearing or pickoff of fibers after being tested in accordance with ASTM F607-03, "Standard Test Method for Adhesion of Gasket Material to Metal Surfaces".
6. The flexibility, both with and across the grain, to bend around a mandrel having a diameter of twelve times the sheet thickness without any visible cracks, breaks or surface separations after being tested in accordance with the "original" and "aged" test methods outlined in ASTM F147-87 (2003), "Standard Test Method for Flexibility of Non Metallic Gasket Materials".

2.5 VACUUM BREAKERS

A. Manufacturers

1. Design Basis: Johnson
2. Other Acceptable Manufacturers:
   a. Watts
   b. Durable check valve or approved equal.

B. Model: VB8-66, VB-75-SS-T, or approved equal.

C. Size: ¾”

D. Body: Stainless steel body with threaded outlet connections.

2.6 AIR VENTS

A. Air valves shall be No. 1A or No. 1B Vari-Vent as may by the Dole Valve Co. or approved equal.

B. Provide steam air valves on steam mains, returns, and unit heaters. Air vents shall be No. 5 air valve as made by the Dole Valve Co., or approved equal.

PART 3 - EXECUTION

3.0 GENERAL

A. Comply with ANSI B31.1 Power piping Code.

B. Steam piping shall be welded and x-rayed as per the minimum requirements of ANSI B31.1.

C. From the point of entry, up to and including the primary and secondary PRV station(s) outlet stop valve(s), and its associated bypass piping and valves(s); including branch connection upstream of the primary and secondary PRV that supplies high pressure steam shall be 100% x-rayed.

3.1 INSPECTION

A. Contractor shall examine location where the piping to be installed and determine space conditions and notify architect in writing of conditions detrimental to proper and timely completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate with other work as necessary to interface installation of piping with other system components of the system.

B. All steam piping shall be pitched (and shall remained pitched in the hot condition) such that there is contiguous drainage from any point in the system to a condensate removal location (steam trap).

C. Where the submissions (drawings and stress analysis) are required by the Owner, insurance provider and/or Steam Business Unit, the Contractor shall prepare all required documentation for approval. Upon completion of the high pressure steam installation, the Contractor shall coordinate with the Steam Business Unit to perform the necessary field inspection of the construction work to verify that requirements and specification have been adhered to.

D. All gaskets shall be made of resilient or pliable materials. The materials selected shall be compatible with fluid and suitable for the pressure-temperature conditions of the service.

3.3 STEAM PIPING

A. All pipe shall be new, free from scale or rust, of the material and weight specified under the various services. Each length of pipe shall be properly marked at the mill for proper identification with name or symbol of manufacturer.

B. All steel piping, except where otherwise rated, shall be standard or extra strong weight, in conformance with the ASTM A-53 Grade A seamless, for piping 2" and larger, as manufactured by National Tube Division, Republic Steel Corp., or approved equal. Piping shall be ASTM A-53 continuous butt weld, for piping less than 2".

C. Where possible, install piping with 1.0” minimum drop in 20’ pipe run in the direction of steam flow. Otherwise, pitch steam and condensate lines downward one inch per 40 feet in direction of flow to ensure adequate flow and prevent noise and water hammer. Steam and return run outs to risers and to elements shall pitch 1/2 inch per foot. At low points of steam lines provide traps adequately sized to collect condensate. Mains shall be dripped at least every 100 feet of run. All supply mains shall be dripped and trapped on any vertical lift, except where otherwise noted.

D. Install branch piping with 1.0” minimum drop in 10’ pipe run in the direction of flow.

E. Install branch piping at top of main, either in vertical direction or at 45 degrees from vertical and perpendicular to main. Branches two pipe sizes smaller than main may be installed as horizontal tees.

F. Provide capped dirt pockets at all traps, riser heels, and wherever dirt and scale may accumulate to meet job conditions, mains shall set up (with drip connections to return line) to maintain headroom, clear other pipes, etc. Steam mains are to be installed as high as possible. System is to be arranged to secure venting of air to the return line at all low points in steam mains, without permitting ingress of air. In any case, where return or drip piping, to meet job conditions, may have to set down under stoops, doors, etc., and again rise after passing these, the sets shall be made up with 45 deg. fittings and with Y-laterals at each end, with brass plugs to permit easy cleaning of trapped portions of pipe. At any points where return mains have to rise again, after being depressed, provide also approved overhead "air lines" (not smaller than 3/4" in size) with adjusting valves, and connect with two high sides. Any turns in water sealed lines shall be made with crosses, with brass plugs in unused outlets to facilitate cleaning. All apparatus subject to high temperature differentials and high steam demand loads such as heating coils and steam-water converters shall have a vacuum breaker.

G. General standards for sizing condensate piping indicate a maximum velocity of 50 fps where mixed phase flow exists.

H. Condensate mains over 2” (two inches) in diameter shall be of extra heavy wall pipe.

3.4 CONDENSATE PIPING

A. Comply with the applicable steam piping installation requirements, except install piping with 1.0” minimum drop in 40’ pipe run in the direction of flow.

B. All drain piping from condensate drain pans shall be properly trapped in accordance with the static pressures involved. Condensate drain piping sizes shall be not less than 1½ “.

3.5 STEAM TRAPS

A. Except as otherwise indicated, furnish and install steam traps of approved types and capacities for proper venting and draining of all piping and of all pieces of equipment:

1. In the return piping adjacent to each item of equipment utilizing steam.
2. At the end of each steam main.
3. At each low point on high pressure system.
4. Heels of risers
5. Any other point where condensate and/or air may collect, such as ahead of pressure and temperature regulating valves, lifts and drops in steam mains, etc.

B. Install with valve and Y-strainer on upstream side of trap.

C. Install float-and-thermostatic traps on low pressure system.

D. Install bucket traps on high pressure system.

E. Install bypass piping around traps on low pressure system.

F. All traps shall be designed for the steam pressure and service for which they are to be used and shall pass all condensate and air automatically, without passing any steam. Traps shall be of the types as specified hereafter, as may be required for satisfactory operation. All steam traps shall be warranted to have been tested in the manufacturer's plant under steam to insure tight closure and satisfactory operation.

G. All equipment steam traps shall be sized for a minimum capacity of 300% of the steam loads indicted on the drawings, and at a maximum pressure drop of 1/2 psi.

1. Exception: For modulating control systems with less than 30 psi inlet pressure, traps shall be sized at 100% of the steam load with a maximum pressure drop of 1/2 psi. Drip legs shall be a minimum of 18”.

H. It shall be this Contractor's responsibility to install the entire system of return line piping so that all condensate will be returned without water hammer.

I. Each heating unit, regardless of type, shall be installed with shut off valve at inlet. Each radiator or convector shall have at its supply inlet, a bronze body valve of packless quick-opening type which shall pass sufficient steam when fully opened to fully heat the radiator surface with the lowest pressure carried in the mains.

J. The following schedule of trap types shall apply:

Schedule of Steam Trap Types

Drips for Low Pressure mains and risers..... FT
Drips for Low Pressure risers under 2 inches..... FT

Radiators, convectors, fin-tube radiators..... T
Airheating, blast coils, preheaters and reheaters.....FT
Heating equipment requiring temperature control.....FT
Unit heaters.....FT

CODE:

FT - Float and Thermostatic Trap
B - Inverted Bucket Trap
T - Thermostatic Trap
F - Float traps without thermostatic vent

K. All traps up to and including 2-1/2" size shall be provided with threaded connections. Traps over 2-1/2" size shall be provided with threaded flanged connection.

L. Traps 2" size or less shall be provided with union connections.

M. Each steam service entrance shall have a low point with a full size dirt leg at least 8” (eight inches) deep, located ahead of the first valve. This dirt leg shall have a 2” (two inch) nipple and cap in the bottom to facilitate cleaning. Trap take-offs shall be at least 2” (two inches) above the bottom. Each leg shall have two take-offs, each equipped with steel body root valves, with 2” (two inches) of vertical separation. Trap connections shall be to the upper connection. Blow-offs shall be connected to the lower port.

N. On the low pressure system, trap selection shall be made based on the load type, amount of allowable piping noise during trap operation, and the possibility of high levels of superheat.

O. Float type traps shall be protected from water hammer where necessary.

3.6 COMBINATION FLOAT AND THERMOSTATIC STEAM TRAPS

A. A gate valve and strainer shall be installed ahead of all float and thermostatic traps.

B. The general arrangement (for 0-75 and 0-125 psig) float and thermostatic traps shall be similar to that of the low pressure float and thermostatic traps with the following exceptions:

1. Valve heads and seats shall be of stainless steel.
2. Air bypasses must be built to the standard of high pressure thermostatic traps, i.e., corrugated phosphor bronze bellows, high temperature solder and stainless steels head and seat.

Body and cover shall be designed for 200 psig steam.

C. General arrangement for high pressure float traps (125-200 psig) shall be as given for medium pressure traps, except that body and covers of semi-steel are designed to withstand 250 psi steam and that exterior air vent is of Thermo-Dynamic type.

3.7 VACUUM BREAKER

A. Install vacuum breakers at:

1. Steam heating coils
2. Heat exchanger
3. Jacketed kettles
4. Closed tanks
5. Hot water generator coils
6. And where shown on drawings or details.

3.8 BYPASS PIPING

A. Except as otherwise indicated, fabricate and install bypass piping using the same materials and the same plane as connected piping, but one pipe size smaller.

B. Include globe valve in bypass piping.

3.9 DRIP LEGS

A. Except as otherwise indicated, fabricate drip legs from 2” pipe.

B. Install to direct steam vertically downward:

1. Include Tee-fitting in vertical pipe.
2. Install dirt leg pipe at 180 degrees outlet of tee-fitting.
3. Close dirt leg pipe with cap.
4. At 90 degrees outlet of Tee-fitting, connect valve, strainer, trap and second valve.

C. Provide trap with continuous flow capacity of 1.5 lbs. per hr. of condensate per sq. ft. of surface drained pipe.

D. Install drip legs:

1. At both ends of steam header.
2. At the low points.
3. At vertical offsets.
4. Elsewhere as indicated.

3.10 STRAINERS FOR STEAM AND CONDENSATE

A. There shall be approved strainers in the inlet connections to each coil, control valve, steam trap, blow-off, and each diaphragm valve, and where else indicated on the drawings. The intention is to protect by strainers, all apparatus of an automatic character, whose proper functioning would be interfered with by dirt on the seat, or by scoring of the seat.

B. Provide approved valved dirt blow-out connections for each strainer (with the valve located 6" to 1'-0" below strainer, or as directed). The blow-out connection shall terminate with a valve, nipple and cap. Blow off shall be 4 pipe sizes smaller than straight pipe - 3/4" minimum size and shall be suitable for a hose connection with cap.

3.11 STEAM AIR VENTS

A. Provide steam air valves on all convectors with maximum operating pressure of 2 lbs.

3.12 TESTING

A. The steam piping system shall be hydrostatically tested upon completion of the installation at 150 percent of the design pressure for all piping pressure unless higher pressure are required by specification section 230593 or elsewhere.

B. See additional requirements elsewhere in the specification.

END OF SECTION 232213

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Installer: A firm with at least five years of successful installation experience on projects with refrigerant piping similar to that required for this project.

1.2 REGULATORY/REQUIREMENTS

A. Comply with applicable requirements of the Clean Air Act and State and local Regulations concerning handling of refrigerants.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. Type ACR copper tube with wrought copper fittings, brazed, 300#, Silver Solder.

1. The silver solder on all connection in the suction, discharge, and liquid lines shall be cadmium-free with a minimum of 45% silver. When soldering components such as vibration eliminators, ball valves, etc., the manufacturer's instruction for brazing or soldering must be followed (wrapping device in a wet cloth, etc.). At all times during brazing or soldering, nitrogen purge shall be used.

B. End Caps:

1. Provide factory applied plastic end caps on each length of pipe and tube.
2. Maintain end caps through shipping, storage and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.

C. All joints shall be in accessible locations. All 90° fittings shall be of the long radius type. Close ruff or short turn ells will not be permitted on any installation. Quick connect couplings are not permitted in any systems.

2.2 SHUT-OFF VALVES

A. Manufacturers:

1. Design Basis: Henry
2. Other Acceptable Manufacturers:
   a. Mueller
   b. Superior
   c. Imperial

B. Size 7/8 Inch and Smaller:

1. Model: Series 600.

2. Type: Pack-less diaphragm.
3. Material: Bronze.
4. Flow: Non-directional.
5. Servicing: Diaphragm changeable under line pressure.

C. Size 1-1/8 Inch and Larger:

1. Model: Series 200.
2. Type: Wing cap, back seating.
3. Material: Bronze.

2.3 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Design Basis: Mason
2. Other Acceptable Manufacturers:
   a. Metraflex
   b. Flexonics

B. Braided bronze with copper tube ends, compatible with refrigerant type for system

C. Flexible connector shall be line size or connection size, whichever is larger.

2.4 REFRIGERATION SPECIALTIES

A. Filter Drier:

1. Conform to ARI Standard 710.
2. Sizes ½" and larger - interchangeable core, full flow.
3. Sizes smaller than ½" - sealed type.
4. Minimum burst pressure - 1500 psig.
5. Refrigerant Filter-Dryer: Refrigerant filter-dryers shall be replaceable core "Catch All" type, as manufactured by Sporlan Valve Company.

B. Sight Glass:

1. Double port moisture indicating, reversible color indicator.
2. Removable sight glass and moisture indicating element.
3. Furnish with a protective cover.

C. Expansion Valve:

1. Thermostatic type, diaphragm or bellows operated.
2. External superheat adjustment factory set for 10ºF superheat (adjustable).
3. Compatible with refrigerant type for the project.
4. Pressure rated per project requirements.
5. Power elements and valve size shall be as recommended by the manufacturer, for the service intended.

6. Thermal expansion valves shall be Type "MVE-G", as manufactured by Sporlan Valve Company, or approved equal, with external equalizer and remote bulb with refrigerant 22 charge.

D. Solenoid Valve:

1. Provide solenoid valve for systems 25 tons and larger.
2. Compatible with refrigerant type for the project.
3. Valve shall fail in closed position (power open).
4. Valves to have stainless steel diaphragm-welded and lead-proof construction, replaceable thermostatic element and tight seating. Valve shall be as manufactured by Sporlan Valve Company or approved equal.

E. Moisture and Liquid Indicator: Provide combination liquid and moisture indicators type "See All", as manufactured by Sporlan Valve Company.

F. Refrigerant Strainers: Provide Refrigerant Strainers. Strainers shall be as manufactured by Henry Valve Company, Type 895.

1. Acceptable Manufacturers:

a. Alco
b. Sporlen

PART 3 - EXECUTION

3.1 INSTALLATION

A. Run piping level or plumb, except slope gas piping to compressor with a minimum number of elbows.

B. Provide oil traps at bottom of suction risers. Size risers for proper oil return.

C. Size lines for total pressure drop not to exceed 2ºF saturation temperature.

D. Provide necessary flexibility for vibration and expansion with offsets and loops, not expansion joints.

E. Provide flexible connectors at all unit connections.

F. Replace air in pipe with dry nitrogen to prevent corrosion during soldering.

G. Install valves, sight glasses, filter-driers, and accessories, furnished by equipment supplier, but not factory installed.

H. Insulate all underground refrigerant lines with ½” flexible foam. Use unslit covering and carefully cement all joints.

3.2 HANGERS

A. For insulated piping, provide hangers of size to fit outside insulation.

B. For non-insulated piping, provide hangers with elastomer insert to prevent damage to piping from vibration.

C. All refrigerant lines must be supported by Unistrut (or equal) hangers and supports. Horizontal suction lines (insulated) may lie on hangers without being clamped, provided they are reasonably fee of movement and secure from vibration. All vertical liquid and suction lines must be clamped. All discharge piping to and from remote air cooled condensers shall also be securely clamped to supports. Clamp assemblies shall be manufactured by Hydra-Zorb or approved equal.

D. All lines that require clamping shall be installed according to the following recommend spacing:

Line Size	Maximum Span
5/8” and smaller	5’-0”
1-1/8”	7’-0”
1-3/8”	8’-0”
1-5/8”	9’-0”
2-1/8”	10’-0”

3.3 TESTING AND DEHYDRATION

A. Refrigeration piping shall be tested in accordance with the recommendation of the refrigeration equipment manufacturer and in the following sequence for a period of 24 hours:

High Side – Nitrogen at 300 psi
Low Side – Nitrogen at 150 psi
Entire System – Refrigerant at 5 psi

B. No visible leaks, losses in pressure or increase in vacuum shall occur during test period.

C. Use the following procedure to test and hydrate the systems:

1. Isolate any elements which would be damaged by test pressures.
2. Test system with trace gas using an appropriate leak detector.
3. Repair or replace leaking elements of system and re-test.
4. After system has been proven to be free of leaks, evacuate it with a high efficiency vacuum pump to 2.5 mm of mercury absolute, to blow off the pressure in the system to atmosphere and provide final evacuation. Use a Zimmerli gauge to read vacuum. Remove all moisture from the system. Operate the vacuum pump until a vacuum of 2.5 mm Hg. is achieved.
5. Allow the system to stand under vacuum for 24 hours.
   a. Then, if a vacuum of 2.5 mm can be drawn within 30 minutes, the system shall be considered dry.
   b. If not, the procedure shall be repeated. Break the vacuum with oil pumped, dry nitrogen, open the compressor suction and discharge service valves and re-evacuate the system to 2.5 mm Hg. absolute. If no noticeable rise in pressure has taken place after 24 hours, the system shall be charged.

6. Break the final vacuum by charging with the correct refrigerant. Refrigerant shall be charged in strict accordance with CFR 40 requirements for refrigerant handling.

3.4 START-UP AND CHECK-OUT

A. In additional to the manufacturer's recommended start-up procedures, the following parameters are to be recorded once the system is stabilized.

Compressor voltage (all phases)
Compressor current (all phases)
Compressor suction pressure/temperature (and superheat)
Compressor discharge pressure/temperature
Evaporator coil suction superheat (not to exceed 10°F)
Outside air temperature

These readings are to be included in the O&M Manual when start-up is complete.

B. All replaceable core filter and filter-drier elements shall be replaced by the Contractor thirty (30) days after system start-up.

END OF SECTION 232300

SECTION 233113 - DUCTWORK

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

A. Fabrication and installation shall be by a single firm specializing and experienced in metal ductwork for not less than 10 years.

B. Comply with SMACNA (Sheet Metal and Air Conditioning Contractors National Association) recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.

C. Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), except as otherwise indicated.

D. Compliance with SMACNA and ASHRAE is a minimum requirement. In case of disagreement between sheet metal work described in this Section and SMACNA or ASHRAE, the specification shall govern, unless the requirements of SMACNA or ASHRAE are of greater value.

E. Comply with SMACNA “HVAC Air Duct Leakage Test Manual” for testing of duct systems.

F. Comply with New York State Energy Conservation Code for UL Listing of products.

G. Comply with NFPA 90A.

1.2 SUBMITTALS

A. Detailed ductwork shop drawings, which include sizes, layouts, and pressure classifications, must be properly submitted. Any ductwork installed without prior written approval by the engineer of record shall be replaced at the expense of the contractor.

B. Shop Drawings: Submit shop drawings for:

1. Transition elbows.
2. Seal and reinforcing schedule for all ductwork fabrication types.
3. Turning vane and turning vane installation.
4. Coordinated duct routing and sizes.

C. Product Data: Submit manufacturer’s product data including VOC content on the following:

1. Duct lining.
2. Duct lining adhesive.
3. Duct sealant

1.3 PRODUCT HANDLING

A. Protect shop fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Protect ends of ductwork and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

1.4 QUALITY ASSURANCE

A. The contractor must comply with the specification in its entirety. If on inspection, the engineer of record finds changes have been made without prior written approval, the contractor will make the applicable changes to comply with this specification at the contractor's expense.

B. At the discretion of the engineer of record, sheet metal gauges and reinforcing may be randomly checked to verify all duct construction is in compliance.

C. All ductwork and fittings must have a computer generated label affixed to each section detailing all applicable information including the duct dimensions, gage, reinforcement type/class, and connector type of systems manufacturer. In addition, galvanizing thickness and country of origin must be clearly displayed on each duct section.

D. Duct sealing shall be sealed as per requirements of SMACNA Air Duct Leakage Test Manual.

1.5 GUARANTEE

A. Contractor will guarantee all work for one year from the date of acceptance against all defects in material, equipment and workmanship. This guarantee shall include repair of damage to any part of the premises resulting from leaks or other defects in material, equipment or workmanship.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTWORK

A. Construct ductwork to meet the functional criteria defined in Section VII of the 2005 SMACNA "HVAC Duct Construction Standards, Metal and Flexible," Second Edition.

B. All ductwork must comply with any applicable local, state, and federal code requirements.

C. Furnish and install the size, connections and run of ducts as indicated on the Drawings. All dimensions represent inside clear dimensions.

D. While the drawings shall be adhered to as closely as possible, the Engineer reserves the right to vary the run and size of ducts during the progress of the work if required to meet structural conditions.

E. Install all ductwork in strict adherence to the ceiling height schedule indicated on the Architect's Drawings. Consult with the Electric and Plumbing Contractors, and in conjunction with the above Contractors, establish the necessary space requirements for each trade.

F. The sheet metal ductwork shall, whether indicated or not, rise and/or drop and/or change in shape to clear any and all conduits, lighting fixtures, plumbing and heating mains to maintain the desired ceiling heights.

G. The ductwork shall be continuous, with airtight joints and seams presenting a smooth surface on the inside and neatly finished on the outside. Ducts shall be constructed with curves shown on the Drawings, the inside radius of all curves and bends shall be not less than width of ducts in plane of bend.

H. Gauge of stainless steel duct shall be same as for steel duct. Seal with Foster 32-19, Childers CP-146 or Ductmate PROseal or approved equal.

I. Provide 12" x 12" access doors for every 50'-0" run of supply and return air duct and at the base of each vertical riser for cleaning purpose.

J. All outside air intake ducts between intake point and air handling unit or mixed air duct or plenum shall be aluminum construction with all joints sealed with Foster 32-19, Childers CP-146 or Ductmate PROseal UL 181B-M listed sealer.

K. All air ducts exposed to the weather and not insulated shall be constructed of aluminum and shall be properly braced and supported and secured to the building construction. All seams shall be sealed with Foster 32-19, Childers CP-146 or Ductmate PROseal UL 181B-M listed sealer.

1. The construction of ductwork shall be same as conventional ductwork except where transverse reinforcing angles not required, provide 1" x 1" x 1/8" black iron bracing angles matched angles at joint and 1" x 1" x 1/8" black iron between joints 4'-0" from joints.
2. Provide 1/8" thick gasket (3M EC-1202 or equal) for all matched angles.
3. Edge of ducts shall be bent 1/2" over matched angles to obtain watertight seal.
4. Rivet angles to duct and seal with Foster 32-19, Childers CP-146 or Ductmate PROseal UL 181B-M listed sealer.
5. Paint bare steel iron angles black after installation.

L. Where dimensions, sizes, and arrangements of elements of duct assembly and support systems are not provided in these standards the contractor shall select configurations suitable for the service.

M. The contractor shall follow the application recommendations of the manufacturer of all hardware and accessory items and select them to be consistent with the duct classification and services.

N. Where sealing is required it means the following:

1. The use of adhesives, gaskets, tape systems, or combinations of these to close openings in the surface of the ductwork and field-erected plenums and casings through which air leakage would occur or the use of continuous welds.
2. The prudent selection and application of sealing methods by fabricators and installers, giving due consideration to the designated pressure class, pressure mode (positive or

negative), chemical compatibility of the closure system, potential movement of mating parts, workmanship, amount and type of handling, cleanliness of surfaces, product shelf life, curing time, and manufacturer-identified exposure limitations.

3. That these provisions apply to duct connections to equipment and to apparatus.

O. Transverse joints for all supply, return, make-up air and outside air ducts serving an application that requires ductwork to be inspected and cleaned periodically shall be gasketed flanged Vanstone joints with minimum 1.5 inch flanges fastened 6 inches on center or “Ductmate” transverse sheet metal duct connection system with manufacturer-furnished gasketing system. Gasket shall be “440 Gasket Tape” by Ductmate Industries, inc. or approved equal.

P. Duct transverse and longitudinal joints (except for the above requirements) shall be selected and used consistent with the static pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions for proper assembly of ductwork outlined in the SMACNA HVAC Duct Construction Standards – Metal and Flexible. Transverse joints T-15 through T-24, shown in Figure 2-1 are acceptable construction. Type L-2 (button punch snap lock) or Type L-3 (grooved seam) longitudinal seams, shown in Figure 2-2, are not acceptable.

Q. Seal all ductwork seams, joints, fastener penetrations and fitting connections with sealants in accordance with SMACNA Seal Classification as required by SMACNA Duct Pressure Classification. All ductwork, regardless of pressure classification, shall have a minimum Seal Class A. Where ducts are not continuously welded, provide liquid, mastic, and embedded fabric tape type sealants or combination, and gaskets as required to meet the specified duct leakage allowance. Sealant composite fire and smoke rating, when tested in accordance with ASTM E 84, NFPA 255 or UL 723, shall not exceed Flame Spread of 25 and Smoke Developed of 50.

R. The aspect ratio (ratio of width to height) of rectangular ducts should be minimized to reduce pressure losses and initial costs. Duct aspect ratios should not exceed 4:1.

2.2 DUCT PENETRATIONS THRU FLOOR

A. Provide 4” high and 4” wide concrete pad all around opening at duct penetrations thru floors. Fill in space between duct and floor construction with mineral wool and fire rated sealant.

2.3 DRAIN PANS

A. Drain pans for cooling coils in built-up units shall be 14 gauge stainless steel with all seams and joints welded. Pan shall be rigidly braced with stiffening angles.

B. Each coil section composing the coil bank to a built-up unit shall have an individual drain pan extending 9" on both sides of the coil with a minimum 2" vertical lip downstream of the coil. The top edge of the lip shall be turned backward. The pans shall be connected with copper tube to permit drainage to the bottom drain pan.

C. Provide aluminum pans and gutters under all equipment subject to leaks mounted above electrical equipment. Each pan shall be properly pitched and a drain outlet provided and piped to drain.

D. Provide insulation under drain pans for cooling coils consisting of 2" thick rigid insulation.

2.4 DUCTWORK MATERIALS

A. All interior ducts shall be constructed with G-90 or better galvanized steel (ASTM A653/653M) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e. kitchen exhausts) shall also be G-90 or better galvanized steel LFP, chem treat.

B. Stainless steel duct shall be fabricated from lock forming grade, 300 series, ASTM-AI67, No. 4 general purpose finish. Protect finish with mill applied adhesive protective plastic/paper throughout construction.

C. Ungalvanized carbon steel shall be lockforming grade, hot rolled steel conforming to ASTM A366 or A619.

D. Flexible Duct shall be factory constructed and listed in accordance with UL 181. Integral fiberglass or mineral fiber insulation shall provide a U value of .25.

2.5 PERMITTED DEFLECTION

A. Joints

1. Up to 48” wide – ¼”
2. 49” – 120” – W/200

B. Sheet

1. 12” and less – 3/8”
2. 13” – 18” – ½”
3. 19” – 24” – 5/8”
4. 25” – 84” – ¾”
5. 85 and larger – 1”

C. Reinforcement

1. Provide mid-panel tie rod, reinforcement and /or where required to control deflection within indicated limits. Details of construction and attachment shall be per SMACNA.

2.6 RECTANGULAR DUCT

A. Construct rectangular ductwork in accordance with Section II and to meet all functional criteria defined in Section VII, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible”, 2005 Edition. All ductwork must comply with all local, state and federal code requirements.

B. All rectangular ductwork, unless otherwise noted, shall be built from galvanized sheet steel and thoroughly braced and stiffened

C. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.

D. Pittsburgh lock shall be used on all “rectangular” duct longitudinal seams. All longitudinal seams shall be sealed with an approved sealant or pre-sealed with an encapsulated mastic or butyl E.P.D.M. rubber on all rectangular duct.

E. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

F. Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

G. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 1995 SMACNA Manual, Second Edition. No other construction pertaining to formed on flanges, will be accepted. Formed on flanges shall be accepted for use on ductwork 42” wide or less, 2” static (positive) or less and must include the use of corners, bolts and cleat.

H. Ductmate type systems that use a butyl Rubber Gasket which meets Mil-C 18969B, Type II Class A, TT-C-1796 A, Type II Class A, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth (as defined in 21CFR 177, 1210 closures with sealing gaskets for food containers).

I. Aluminum duct shall be fabricated using the aluminum thickness equivalence table in the standard. Simply increasing the thickness by two gauges is not acceptable.

J. Fittings shall be constructed and reinforced as ductwork according to the longest span.

K. For duct construction pressure 2” w.g. or below based on external static pressure of fan:

1. Flat areas of duct over 18 in. wide shall be stiffened by cross breaking or beading.
2. All joints to have corner closures.
3. All joints shall be sealed with Foster 32-19, Childers CP-146 or Ductmate PROseal UL 181B-M listed mastic.

L. For duct construction pressure 2-5” w.g. based on external static pressure of fan:

1. All seams on fitting shall be continuously welded. If the zinc coating is burned off the steel during welding, apply zinc chromate paint to prevent corrosion.
2. Companion angles shall be bolted to each other with 1/4 in. x 3/4 in. stove bolts, spaced not more than 6 inches apart.
3. Hangers shall be as described for conventional ducts, except that they shall be fastened to the reinforcing angles, or angle connections. Where this is not feasible cradle hangers with a bottom angle shall be used; angle shall be suspended by angles or rods. Piercing of ducts by hangers, pipes, fasteners, etc., will not be permitted.

2.7 ROUND AND OVAL DUCT

A. Round and oval duct shall be galvanized steel, constructed in accordance with SMACNA “Duct Construction Standards, Metal and Flexible”, except as noted. Duct shall be minimum 22

gauge. Submit product data sustaining the equivalency of such duct into SMACNA standard duct.

B. Provide flat side reinforcement of oval ducts as recommended by SMACNA standards. Do not use internal tie rod reinforcement unless specifically approved by Engineer.

C. Round ductwork shall be spiral lock seam for round ductwork systems higher than 2". Example: Ductmate, Greenseam or approved equal. Gauges shall be in accordance with SMACNA Duct Construction Standard and fittings in accordance with SMACNA Duct Construction Standard, except as noted.

1. Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3-inch wide duct tape.
2. Companion angles shall be bolted to each other with 1/4 in. x 3/4 in. stove bolts, spaced not more than 6 inches apart.
3. Hangers shall be as described for conventional ducts, except that they shall be fastened to the reinforcing angles, or angle connections. Where this is not feasible cradle hangers with a bottom angle shall be used; angle shall be suspended by angles or rods. Piercing of ducts by hangers, pipes, fasteners, etc., will not be permitted.

D. Fittings shall be continuously welded, standing seam, or spot welded and sealed. Metal thickness and reinforcing shall be equivalent to the requirements of the largest span.

1. All elbows greater than 45" shall be radius type, R=1.5 times duct diameter.
2. Elbows less than 12" shall be of die stamped construction. Elbows 12" or greater shall be 5-piece construction.
3. Diverging and converging flow fittings shall be constructed with no excess material projecting from the body into the branch tap entrance. All such fittings shall be 45° "shoe" entrance, wye plus elbow, or 45° lateral branch. Special fittings such as heel tapped elbows and bullhead tees may be used only where shown on drawings. Adjustable elbows and straight saddle taps shall not be used. Low pressure adjustable elbows acceptable.
4. Provide bell mouth, conical tees or taps, laterals, reducers, and other low loss fittings as shown in SMACNA standard.
5. Coat galvanized areas of fitting damaged by welding with corrosion resistant aluminum paint or galvanized repair compound.

E. For duct construction pressure 2" w.g. or below:

1. Longitudinal seam sealed, self-locking snaplock duct is acceptable for round ductwork systems of 2" w.g. and lower.
2. All round snaplock pipe longitudinal seams shall be sealed with an E.P.D.M. rubber on all round self-locking longitudinal round pipe. Approved Manufacturer: Ductmate Industries "Green Seam" self-locking longitudinal round pipe or approved equal.

2.8 ALUMINUM DUCTWORK

A. Where transverse reinforcing angles are not required provide 1"x1"x1/8" black iron matched angles at joints and between joints at a maximum spacing of 4 feet.

B. Provide 1/8" thick gasket at all matched angles. Edge of duct shall be bent ½" over matched angle to obtain watertight seal. Rivet angle to duct and seal with listed sealer. Paint black iron angles prior to installation.

C. Aluminum ductwork shall be fabricated using the aluminum thickness specified in the standard. Increasing galvanized gauge by 2 gauges is not acceptable.

D. Aluminum duct shall be fabricated from lock forming grade, ally 3003-HI4, ASTM B209. Reinforcing angles, bars, tie rods, and other structural members shall be alloy 6061-T6. Hangers shall be 6061-T6 aluminum, or galvanized or painted steel with a dielectric isolation pad between the dissimilar metals.

2.9 EXTERIOR INSULATED DUCTWORK

A. Exterior insulated ductwork shall be constructed as double wall aluminum duct with a 2" interstitial space packed with insulation.

B. Top of duct shall be sloped to drain at ¼" per foot.

C. Ductwork observed to pond water shall be replaced by contractor at his expense.

D. Wrap exterior of ductwork in one layer of EPDM roofing with seams sealed to prevent water entry. Seams shall be arranged to shed water.

2.10 EXTERIOR UNINSULATED DUCTWORK

A. Top of duct shall be sloped to drain at 1/4" per foot.

B. Any ductwork observed to pond water shall be replaced by contractor at his expense.

2.11 FLEXIBLE DUCTWORK

A. Duct shall conform to NFPA 90 and be UL listed.

B. Insulation shall be on the exterior of duct.

C. Maximum length shall be 6 feet or less.

D. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 200 mm (8 inches) in diameter shall be Class 1. Ducts 200 mm (8 inches) in diameter and smaller may be Class 1 or Class 2.

E. Factory made including mineral fiber insulation with maximum C factor of 0.25 at 24 degrees C (75 degrees F) mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per 300 mm (foot) of straight duct, at 500 Hz, based on 150 mm (6 inch) duct, of 750 m/min (2500 fpm).

2.12 FUME HOODS

A. Material: (Non Corrosive Vapors)

1. Stainless steel type 316.
2. 18 Gauge
3. Welded joints.

B. Material: (Corrosive Vapors)

1. PVC Type 1, Grade 1, Schedule 10
2. Solvent welded.

C. Construction: *All joints shall be sealed tight with Ductmate PROseal UL 181B-M listed or approved equal sealer. Connections from fume hood ductwork to fans shall be thru acid resistant rubber, not less than 6” long, fume tight and securely fastened with copper metal bands.

2.13 CONTRACTOR FABRICATED CASINGS AND PLENUMS

A. Unless required otherwise by drawings, single wall casings and plenums may either be contractor or factory fabricated where shown on drawings. All double wall casings and plenums shall be factory fabricated.

B. Casings and plenums shall be constructed in accordance with the 2005 SMACNA “HVAC Duct Construction Standards” and as specified below.

C. All casings and plenums on the suction side of any fan, including return air outside air, or mixing plenum shall be constructed to 2” negative pressure class.

D. Louver blank-off panels shall be constructed to 2” negative pressure class.

E. All casings and plenums for relief and exhaust air shall be 2” positive or negative pressure class.

F. All casings and plenums on the discharge side of supply fans shall be 4” positive pressure class.

G. Single wall plenums shall be of the standing seam type construction. Submit shop drawings indicating overall dimensions, support details, corner & edge details, penetration details, equipment installation details, and pressure class.

H. Seal all seams, edges, and corners with approved duct sealant.

I. Casing materials shall be the same as that for the connected duct systems.

J. Where automatic dampers may, completely shut off air flow and subject plenum of casing to fan close off pressure, install pressure relief panels, rated to open at 125%.

2.14 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of the types and sizes indicated, and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Double wall turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert table, which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs. when fastened per the manufacturers instructions. Approved Systems: Ductmate PRO-Rail.

C. Single wall splitter and turning vanes shall be custom fabricated as specified below.

D. Ductwork Support Materials: Except as otherwise indicated, provide galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

E. Duct Sealant:

1. Products:

a. United McGill
b. Ductmate Industries, Inc., PROSeal
c. Hardcast, Versa-grip 181
d. Precision
e. Uni-Mastic 181 Duct Sealer, UL Listed - Indoor
f. Unicast, PROseal - Outdoor

2. Description: Non-hardening, liquid or mastic elastic sealant.
3. Fire Rating: UL 289U listed and NFC 220(b).
4. UL listed: UL 181A/B listed

2.15 DUCT TAPE ROLLED SEALANT SEALING SYSTEM:

A. Manufacturers:

1. Design Basis: Hardcast. Foil-Grip 1402 181B-FX, UL listed.

B. Model:
1. Tape: DT
2. Indoor Adhesive: FTA-20
3. Outdoor Adhesive: RTA-50

2.16 FIBERGLASS DUCTBOARD

A. Fiberglass ductboard is not accepted without prior written approval from the specifier.

2.17 ACCESS DOORS

A. Wherever necessary in ductwork, casings or sheet metal partitions, provide suitable access doors and frames to permit inspections, operation and maintenance of all valves, coils, humidifiers, controls, smoke dampers, smoke detectors, fire dampers, filters, bearings, traps, or other apparatus concealed behind the sheet metal work. All such doors shall be of double construction of not less than No. 20 gauge sheet metal and shall have sponge rubber gaskets around their entire perimeter. Doors in insulated ducts of insulated casings shall have rigid fiberglass insulation between the metal panels.

B. All access doors in sheet metal ducts shall be hung on heavy flat hinges and shall be secured in the closed position by means of cast zinc clinching type latches. Where space conditions preclude hinges, use four heavy window type latches.

C. Doors into ducts shall in general not be smaller than 18" x 18" except for access door to fire dampers which will depend on size of fire damper.

D. Provide insulated or acoustically lined doors to prevent condensation where applicable.

E. Systems 3” w.g. or less shall utilize a hinged, cam, or hinged & cam square-framed access door.

2.18 FLEXIBLE DUCT CONNECTOR

A. Flexible duct connector shall be used where ductwork connects to fans of apparatus, or apparatus casing to fans so as to prohibit the transfer of vibration from fans to ductwork connecting thereto. Connectors will meet NFPA 90A and 90B specifications and provide an airtight and waterproof seal. Indoor installations shall be Neoprene or vinyl coated fabrics. Outdoor installations shall use Hypalon coated fabric. Connector shall be Ductmate PROFlex or approved equal.

B. The flexible connections shall be a minimum of 12" long including bands using extra wide fabric as specified and held in place with heavy metal bands, securely attached, to prevent any leakage at the connection points. The fabric shall have a maximum length of 10”.

C. Flexible connections shall be fabricated from an approved flame retardant fabric each having a maximum flame spread index/rating of 25 and a maximum smoke developed ration of 50.

Range hood exhaust Installations shall be Flame-Proof Silvaseal by Duro Dyne, Ductmate PROflex Neoprene, or equal.

Low Pressure Systems - neoprene coated glass fabric
- 30 ounce/sq. yd.

D. Flexible connections shall not be painted.

E. Flexible connections shall be installed between all rigid ductwork or casing and all air handling equipment.

2.19 ROOF MOUNTED DUCT SUPPORTS

A. Duct on roof shall be supported by an engineered prefabricated system specifically designed to be installed on the roof without roof penetrations, flashing or damage to the roofing material. The system shall consist of linear curbs with spread bases located along the length of the duct with a trapeze constructed to support the underside of the duct. The system shall be custom designed to fit the duct to be installed and the actual conditions of service. Loading shall not exceed 15 PSF of bearing surface.

B. Duct finishes shall be constructed independently of the support system and shall not be enveloped in the support system.

C. Curbs shall be located to bear on structural elements of the roof deck, not the roof deck itself.

2.20 SEISMIC RESTRAINTS

A. Provide seismic restraints as required for seismic zone.

2.21 HANGER AND SUPPORT MATERIALS

A. Hang and support ductwork as defined in Section 5 of the 2005 SMACNA Manual, “HVAC Duct Construction Standards, Metal & Flexible” Third Edition or as defined within.

B. Aircraft cable hanging system with easy lightweight mechanical adjustment system shall not be used for hanging HVAC and other mechanical applications.

C. Supports, bar / angle reinforcements, and other products that are not part of the duct that are manufactured of uncoated mild steel shall either be painted with two coats of primer or shall be manufactured of a galvanized equivalent material.

D. Hanger spacing not to exceed 8 feet.

2.22 FABRICATION

A. Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible” 2005 Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.

B. Ducts shall be neatly finished on the outside with all sharp edges removed.

C. Inside surfaces shall be smooth with no projections into the air stream except where otherwise indicated.

D. Transverse joints shall be made airtight with all laps in the directions of air flow.

E. All fasteners and attachments shall be made of the same material as the ducts.

F. Furnish test wells 12" on the center horizontally and vertically in the suction and discharge duct of each fan. Test wells shall consist of a 1" x 3/4", 125 lb., bronze, screwed hex bushing, secured to the duct with a bronze hex locknut on the inside of the duct. A 3/4" x 2" long

standard weight bronze, screwed nipple and cap shall be fitted to the housing on the outside of the duct. Test wells shall be no. 699 as made by Ventlok or approved equal.

G. Make all changes in direction using 1.5 radius elbows where possible. Use splitter vanes or mitered rectangular elbows with turning vanes otherwise.

1. Use single thickness splitter vanes for all radius elbows less than 1.5 D = r.
   a. D = diameter of duct or width of duct (in plane of change-in-direction).
   b. r = radius of duct at duct center-line.
   c. Use “Curve Ratios” of 0.45 or greater (as defined by figure 3-7 of the 1989 ASHRAE Fundamentals Handbook).
2. Use single thickness turning vanes with no trailing edges in accordance with SMACNA Standards.
   a. All mitered, rectangular elbows in series.
   b. All mitered, rectangular elbows less than 36” in width (in plane of change-of-direction).
3. Use double width, airfoil type turning vanes with no trailing edges for all, rectangular elbows greater than 36” in width (in plane of change-of-direction).
   a. Isolated elbows have a minimum of 3D straight duct upstream and downstream of the change-in-direction.

H. Fabricate transition elbows with turning vanes at correct angle so entering and leaving edges are parallel or tangent to air flow.

I. All square elbows shall have factory-designed and built turning vanes with hollow vanes having different inside and outside curvature, similar to Tuttle and Bailey, Inc., "Ducturns". Shop fabrication vanes will not be approved. Where turning vanes are in conflict with the access doors to fire dampers. They shall be made movable, so that fire dampers shall be accessible.

J. All branch duct take-offs shall use 45° laterals or 45° “pants-leg” type fittings.

K. Dissimilar metals shall be connected with flanged joints made up with fiber or neoprene gaskets to prevent contact between dissimilar metals. Flanges shall be fastened with bolts protected by ferrules and washers made of the same materials as the gaskets. Where an aluminum duct is to be connected to a galvanized steel duct, the end of the galvanized steel duct shall be coated with heavy black asphaltum paint before connecting it to the aluminum duct.

L. Changes in shape and dimension shall conform to the following: Except where otherwise noted, for increases, in cross-sectional area, the shape of the transformation shall not exceed 1" in 7". Except where otherwise noted, for reductions in area, the slope shall not be less than 1" in 4" but 1" in 7" preferred.

M. Wherever it may be necessary to make provisions for vertical hangers of the ceiling construction passing through ducts, provide streamlined shaped sleeves around such ceiling construction hangers as to fully protect the duct from being punched with holes for the passage of such hangers. Any such streamlined sleeves shall be made air tight at top and bottom of ducts. In no case shall there be more than two rods in any 9 sq. ft. area. No rods shall pierce ducts smaller than 12" in horizontal area.

N. Fastener material shall match duct material.

2.23 DUCT CONSTRUCTION SCHEDULE

	Material	Gauge	Joints	Pressure Class	Seal Class
Rectangular supply air duct upstream of VAV	Galv.	SMACNA	SMACNA	10”	A
Round and oval supply air duct upstream of VAV	Galv	SMACNA	SMACNA	10”	A
Supply air duct downstream of VAV	Galv	SMACNA	SMACNA	2”	A
Round and oval supply air duct downstream of VAV	Galv	SMACNA	SMACNA	2”	A
Return air duct	Galv	SMACNA	SMACNA	-4”	A
Rectangular constant volume supply duct	Galv	SMACNA	SMACNA	6”	A
Laboratory general exhaust	Galv	SMACNA	SMACNA	6”	A
Fume hood exhaust	316 SST	SMACNA, 18 Ga. min.	Welded	-6”	N/A
Outside air duct	Aluminum	SMACNA	SMACNA	2”	A
General Exhaust	Galv	SMACNA	SMACNA	-4”	A
Toilet exhaust	Galv	SMACNA	SMACNA	-4”	A
Uninsulated exterior duct. Unless otherwise identified or SST	Alum	SMACNA, Min. 22 Ga.	SMACNA	6”, -6”	A
Fan coil and evaporator supply	Galv	SMACNA	SMACNA	2”	A
Exterior insulated duct	Double wall aluminum	SMACNA	SMACNA Watertight	-6”, +6”	A
Exterior exhaust duct unless SST	Aluminum	SMACNA	SMACNA Watertight	-6”	A

2.24 FIRE DAMPERS

A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 70 degrees C (160 degrees F) fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

B. Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.

C. Minimum requirements for fire dampers:

1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 1.9 mm (14 gage), required to provide installation equivalent to the damper manufacturer's UL test installation.
2. Submit manufacturer's installation instructions conforming to UL rating test.

2.25 SMOKE DAMPERS

A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 450 m/min (1500 fpm). Maximum static pressure loss: 32 Pa (0.l13 inch W.G.).

B. Maximum air leakage, closed damper: 0.32 cubic meters/min/square meter (4.0 CFM per square foot) at 750 Pa (3 inch W.G.) differential pressure.

C. Minimum requirements for dampers:

1. Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
3. Blades; Galvanized steel, parallel type preferable, 300 mm (12 inch) maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
4. Shafts: Galvanized steel.
5. Bearings: Nylon, bronze sleeve or ball type.
6. Hardware: Zinc plated.
7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.

D. Motor operator (actuator): Provide pneumatic or electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

2.26 COMBINATION FIRE AND SMOKE DAMPER

A. Combination fire and smoke dampers: Multi-blade type units meeting all requirements of both fire dampers and smoke dampers shall be used where shown and may be used at the Contractor's option where applicable.

2.27 INSTRUMENT TEST FITTINGS

A. Manufactured type with a minimum 50 mm (two inch) length for insulated duct, and a minimum 25 mm (one inch) length for duct not insulated. Test hole shall have a flat gasket for rectangular ducts and a concave gasket for round ducts at the base, and a screw cap to prevent air leakage.

B. Provide instrument test holes at each duct or casing mounted temperature sensor or transmitter, and at entering and leaving side of each heating coil, cooling coil, and heat recovery unit.

PART 3 - EXECUTION

3.1 INSPECTION

A. Contractor shall examine location where ductwork is to be installed and determine space conditions and notify Architect in writing of conditions detrimental to proper and timely completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DUCTWORK

A. Assemble and install ductwork in accordance with recognized industry practices, which will achieve air-tight and noiseless systems, capable of performing each indicated service.

B. Duct sizes shown on the Drawings at connection to fans or other equipment may vary in actual installation. Contractor shall provide transition pieces as required.

C. Fittings shall be configured to provide the least possible pressure drop.

D. Install each run with a minimum of joints.

E. Align ductwork accurately at connections, within 1/8” misalignment tolerance and with internal surfaces smooth.

F. Support ducts rigidly with suitable ties, braces, hangers and anchors of the type, which will hold ducts true-to-shape to prevent buckling. Supports shall be placed at each joint and change in direction up to a maximum spacing of 8 feet on centers.

G. Seal ducts in accordance with SMACNA requirements for pressure class indicated.

1. Indoor Ducts: Use liquid or mastic sealant, or tape system.
2. Outdoor Ducts: Use tape system.
3. Approved manufactured joining systems with gaskets may be used in lieu of transverse sealing.

H. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Casing and hangers shall be installed straight and level and all shall be free of vibration and noise when fans are operating.

I. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of the building.

1. Limit clearance to 0.5” where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
2. Where possible, locate insulated ductwork for 1.0” clearance outside of insulation.

J. Ducts at ceilings shall be suspended from inserts in concrete slabs except where otherwise indicated. Inserts shall be Grinnel Fig. 279, 282, or 152 as required. Each duct shall be independently supported and shall not be hung from or supported by another duct, pipe, conduit or equipment of any trade. Duct hung below slabs less than 4” thick shall be supported from supplemental steel.

K. All fastenings to building structure shall be adequate to insure permanent stability of sheet metal work and shall be capable of resisting all applied forces.

L. Vertical ducts in shafts or passing through floors shall be supported by steel angles or channels, welded, riveted, screwed or bolted to ducts and fastened to building structural members at each floor level. Provide safeing to close all floor openings around ductwork - pack annular space with rockwool and 18 gauge sheet metal safeing. Floor openings in plenums shall have 1/2 inch diameter steel bars constructed in a 6”x6” grid.

M. Rigid connections between ductwork and non-rotating equipment shall be 12 inch on centers and shall be made with flanged joints, sealed with fireproof material (Fiber or Neoprene gaskets).

N. In finished spaces, conceal ductwork by locating in mechanical shafts, hollow wall construction or above suspended ceilings.

O. Where possible, avoid locating ducts on or near floor.

1. Where ducts must be located low, provide metal trestle to protect duct at places where duct will be climbed over.
2. Ducts at floor shall be supported by steel angles suitably anchored to floor construction.

P. Coordinate the layout with suspended ceiling and lighting layouts and similar finished work as well as other components of systems.

Q. Install access doors where necessary for inspection and maintenance.

1. Provide additional 12” x 12” access door at each low leakage damper.
2. Arrange access doors so that:
   a. They open against the system air pressure wherever feasible.
   b. Their latches are operable from either side, except where the duct is too small to be entered.

R. Where ducts pass through non-fire-rated interior partitions below ceiling and exterior walls:

1. Conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct.
2. Overlap the opening on all sides by at least 1-1½".

S. Provide volume dampers at all branch take-offs.

T. Provide volume dampers as needed downstream of all VAV boxes with electric heating coils in order to create sufficient total pressure to allow airflow switch to activate as per Section 23 82 16.

U. Provide conical or tapered taps with balancing dampers on all round ductwork takeoffs.

V. Where space permits, round or oval ductwork of equivalent diameter may be substituted for unlined rectangular ductwork.

W. Provide 22-gauge aluminum ductwork for the first 20 feet downstream of any aluminum grille. Slope duct towards grille at 1/8" /ft.

X. It is the intent to obtain ductwork construction with minimum leakage. The construction noted in Specifications can produce low or high leakage rates, depending upon the workmanship, particularly with regard to the connection at the top of the ducts. Guarantee that total diffuser volume, measured by means of velometer, shall be at least 95% of actual fan supply (measured by means of a duct traverse tank with a Pitot tube and water manometer). Seal the ductwork at joints with suitable sealers Ductmate PROseal sealant and tape. Use of "HARDCAST" or any other material is subject to Architect's approval.

Y. Lab exhaust ductwork shall extend a minimum of 10' above roof surface.

Z. All exhausts from lab hoods and lab equipment must comply with NYSDEC permit requirements including 6NYCRR Parts 201 & 212.

AA. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner, when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.

BB. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.

CC. Construct casing, eliminators, and pipe penetrations in accordance with SMACNA Standards.

DD. Install fire dampers, smoke dampers and combination fire/smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations indicated and where ducts penetrate fire rated and/or smoke rated walls, shafts and where required by the Resident Engineer. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers to the Resident Engineer.

EE. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.

FF. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 1.5 (5 feet). Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.

GG. Temperature range: -18 to 93 degrees C (0 to 20 degrees F) internal.

HH. Maximum working velocity: 1200 m/min (4000 feet per minute)

II. Minimum working pressure, inches of water gage: 2500 Pa (10 inches) positive, 500 Pa (2 inches) negative.

JJ. Duct Clamps: 100 percent nylon strap, 80 kg (175 pounds) minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

KK. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 4 feet long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated on hour or two hour. Support ducts SMACNA Standards.

LL. Where diffusers, registers and grilles cannot be installed to avoid seeing inside the duct, paint the inside of the duct with flat black paint to reduce visibility.

MM. Control Damper Installation:

1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
2. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.

NN. Air Flow Measuring Devices (AFMD): Install units with minimum straight run distances, upstream and downstream as recommended by the manufacturer.

3.3 DUCT HANGERS

A. Low pressure ducts up to 24" on a side or up to 20" diameter shall be suspended with 16 gauge, galvanized strap hangers, 1" wide.

B. Low pressure ducts 25" to 40" on a side or 21" to 40" diameter shall be suspended with galvanized strap hangers 1" wide by 1/8" thick.

C. Strap hangers shall be bent 90˚, extended down sides of ducts and turned under bottom of ducts a minimum of 2". Strap hangers shall be fastened at ceiling with nuts, bolts and lock washers and to sides and bottom of ducts with sheet metal screws.

D. All medium and high pressure ductwork and low pressure ducts 41" and larger on a side or diameter shall be suspended with either rod or angle type hangers. No screws shall penetrate medium and high pressure ductwork.

E. Rod type hangers shall be 3/8" diameter black steel rods threaded at both ends and bottom bracing angles on ducts, with nuts and lock washers.

F. Angle type hangers shall be extensions of side bracing angles on ducts, bent 90° at ceiling and fastened with nuts, bolts and lock washers.

G. Hangers for vertical ducts shall be as per SMACNA Duct Manual.

H. Stainless steel ductwork shall be supported with rod or angle type hangers, so that there will be no penetration of the stainless steel ducts.

I. Provide supplemental steel to span structure in areas where duct cannot be otherwise supported from primary structure.

J. Do not support ductwork from pipe, other ducts, ceiling system, metal deck, metal roof deck or furring.

K. Do not hang lighting or pipes from ductwork.

L. Do not use perforated hanger straps to support ductwork.

3.4 DUCT LEAKAGE TESTING

A. Installed ductwork shall be pretested prior to installation of access doors, take-offs, etc.

B. All leak testing shall be witnessed by the Engineer or representative of the Engineer. The Contractor shall give the Engineer 72 hours notice prior to testing. Any testing not witnessed by the Engineer or his/her representative, shall be considered invalid and will be redone.

C. Test the ductwork leakage for each system (air handler, exhaust fan, return fan, etc.) and totalize leakage on a per system basis.

D. Use the leakage formula from section 4 of the SMACNA HVAC Air Duct Leakage Testing Manual, 1st edition, for calculating the allowable leakage for each section of ductwork based on the leakage classifications listed below:

1. Pressure classification 4” and over- Leakage Class 6
2. Pressure classification 3” - Leakage Class 12
3. Pressure classification 2” - Leakage Class 24

E. All volume dampers, fire and fire smoke dampers, and duct access doors shall be installed prior to the testing; no additional leakage rates will be allowed for these components. In-duct coils and VAV boxes are not to be included in the leakage testing.

F. Provide summary reports for each system on a single table which list each section tested, surface area of tested section, allowable leakage, and measure leakage. Include the measured velocity pressure from the testing rig and a legible copy of the nomegraph used to determine the actual flowrate.

G. The final testing shall be performed as follows:

1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
2. Use a certified orifice tube for measuring the leakage.
3. Define section of system to be tested and blank off.
4. Determine the percentage of the system being tested.
5. Using the percentage, determine the allowable leakage (cfm) for that section being tested.
6. Pressurize to 1.5 times operating pressure and repair any significant or audible leaks.
7. Repressurize and measure leakage.
8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

NOTE: It is recommended that the first 100'-300' of ductwork installed be tested to insure the quality of the workmanship at an early stage.

H. All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements.

I. Constant Volume Systems/Supply Ductwork	
Allowable Leakage	1% of design cfm
J. Constant Volume Systems/Return Ductwork	
Allowable Leakage	2% of design cfm
K. Variable Air Volume Systems/Supply Ductwork	
Fan to VAV Boxes	1% of design cfm
VAV Boxes to Registers	2% of design cfm
L. Variable Air Volume Systems/Return Ductwork	
Allowable Leakage	2% of design cfm
M. Exhaust Systems	2% of design cfm

3.5 DUCTWORK STORAGE AND CLEANING

A. Cleaning:

1. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris.
2. Clean external surfaces of foreign substances which might cause corrosion of metal or deterioration of paint.

B. Protection:

1. Store duct a minimum of 4” above ground or floor to avoid damage from weather or spills.
2. When internally cleaning duct work prior to installation or shipment to the jobsite, all duct ends and openings must be covered prior to transporting with a dual Polyethylene protective film. Film must be securely affixed to protect against dirt and debris and must be translucent to facilitate inspection of interior surfaces without removing film. Film must have a minimum elongation of 600%, contain no VOC and leave no residue on duct after removal. Approved Manufacturer: Ductmate Industries ProGuard or approved equal.
3. Cleaning of new and existing supply ductwork in existing buildings. After completion of ductwork installation purge ductwork as follows:

    a. Cover all supply registers and diffusers with oil cheese cloth.
    b. Use supply fan and install temporary fan to provide air to the system for twelve (12) hours at 200% design flow.
    c. Remove oil cheese cloth.

C. Ductwork contaminated or damaged above “shop” or “mill” conditions shall be cleaned, repaired or replaced to the Engineer’s satisfaction.

1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.
2. Ductliner in installed ductwork, which has become wet must be completely removed and replaced.
3. Torn ductliner may be replaced by coating with adhesive if damaged is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

3.6 ACCESS DOORS

A. Install access doors where necessary for inspection, adjustment or servicing. In no case shall access to any items of equipment requiring inspection, adjustment, or servicing require the removal of nuts, bolts, screws, wing nuts, wedges, or any other screwed or loose device. Access doors shall be minimum 18”x 18” unless duct size requires a smaller door.

B. Arrange access doors so that:

1. They open against the system air pressure, wherever feasible.
2. Their latches are operable from either side, except where the duct is too small to be entered.

C. Provide access doors as follows:

1. Downstream and upstream side of coils within 3'-0" of coil.
2. Upstream and downstream of each humidifier.
3. Every 50’ along length of duct requiring cleaning.
4. At each automatically controlled damper, fire damper, smoke damper or fire/smoke damper.
5. In paint spray booth exhaust, provide access door at each sprinkler head.
6. Every 12” along length of kitchen exhaust duct.
7. On actuator side of each motorized damper.
8. At the base of all risers.

9. At all intake plenums.
10. At all smoke detectors.
11. At all valves, controls, filters, bearings, traps, drains, etc.

D. Hinges shall be Ventlok No. 150 or 260 with or without screw holes or approved equal. Latch for walk-in access doors shall be No. 260 as made by Ventlok Co. or approved equal. Latch for access door in ductwork shall be Ventlok No. 100 or approved equal.

E. Provide 4” high and 4” wide concrete pad all around opening at duct penetrations thru floors. Fill in space between duct and floor construction with mineral wool and fire rated sealant.

END OF SECTION 233113

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

A. Comply with SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) latest recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data on the following:

1. Flexible duct
2. Fire dampers
3. Smoke dampers
4. Louvers

PART 2 - PRODUCTS

2.1 FLEXIBLE DUCT ACOUSTICAL

A. Manufacturers:

1. Flexmaster Type 8M, or approved equal.

B. Construction:

1. CPE Liner film mechanically locked without adhesives.
2. Insulation: Minimum 1-½" thick fiberglass blanket with a polyethylene vapor barrier. Map 0.23 'c' factor, factory installed.
3. Helix: Corrosion resistant galvanized steel.

C. Pressure rating: 6" w.g. positive, 1" w.g. negative at maximum 180°F operating temperature.

D. Standards: NFPA90A UL-181, Class I, ASTM E-96 - Procedure A.

E. Insertion loss shall be at least:

	OCTIVE BAND (Hz)					
Duct Size	125	230	400	1000	2000	4000
6"	7	31	40	38	40	27
8"	13	29	36	35	38	22
	DB reduction for 10 foot length tested in accordance with ASCME 477.					

2.2 FLEXIBLE DUCT, HIGH PRESSURE

A. Manufacturers:

1. Design Basis: Flexmaster Type 3
2. Other Acceptable Manufacturers:
   a. Thermaflex, MKC
   b. Genflex, IGE
   c. American/Elgen

B. Construction:

1. Insulated: Reinforced inner liner, mechanically locked or bonded together by a corrosive resistant galvanized steel helix, Min. 1-½" thick fiberglass blanket with polyethylene vapor barrier. Max. 0.23 'c' factor.
2. Uninsulated: Mechanically locked without adhesives with a corrosion resistant galvanized steel helix.
3. Aluminum: Mechanical lock without adhesives.

C. Pressure rating: 12" w.g. positive, 1" w.g. negative at 180^0F.

D. Standards: NFPA90A, UL-181 Class I, ASTM E96 - Procedure A.

2.3 DIFFUSER PLATE

A. Provide diffuser plates upstream of heating coils in high pressure duct systems. Diffuser shall be 1/8" thick plate perforated with 1/2" diameter holes with 48 percent free area. Plates shall be made maximum dimensions of 24" x 48" sections, bolted together with 1-1/2" x 2-1/2" x 1/8" tees. Plates shall be removable and entire construction shall be rigid.

2.4 FLEXIBLE RUN-OUTS

A. The run-outs from medium or high pressure duct to terminal units such as Variable air Volume or Constant Air Volume boxes, induction units, or air mixing boxes may be flexible duct.

B. Flexible metal duct shall be all-metal, boundable, self-supporting and mechanically interlocked to be totally leak proof under operating conditions without manufacturing use of adhesives.

C. Flexible ducts shall be type AL006 uninsulated or Type AL006-150 insulated as made by United Sheet Metal or approved equal. The flexible run-outs shall take all bends without kinking. The run-outs shall be flame resistant, shall have a low friction loss, and shall have working pressure minimum off 10 inch W.G. Flexible run-outs shall be no longer than 5'-0" and shall comply with Local Union Requirements. Any additional lengths necessary to connect the flexible duct to the high or medium pressure ductwork shall be made with spiral lockseam sheet metal duct of the same size as the flexible ductwork.

D. The flexible run-out duct shall meet all requirements of the National Fire Protection Association 90A - Latest Edition. Flame spread not over 25, smoke developed not over 50.

E. Each flexible run-out duct shall be sealed to its male outlets on both ends with 3M EC-800 sealer, or sealing compound as recommended by the flexible air duct manufacturer. The flexible air duct shall be sealed and covered to a minimum depth of 2 inches of its mating metal coupling, branch take-off lap or duct at each of its ends. A Wraplock Ideal No. 5900 Strap-Clamp shall be furnished and installed at each end of the flexible duct.

F. Complete installation shall be airtight.

2.5 LOUVERS

A. Final Louver selections shall be reviewed and approved by the architect.

B. Manufacturers:

1. Design Basis: Greenheck
2. Other Acceptable Manufacturers:
   a. Arrow
   b. Pottorff
   c. Moore
   d. Ruskin
   e. United Air

C. Screens: ½" mesh, .063" aluminum wire.

D. Blades: Of depth shown by schedule, drainable.

E. Rating Basis:

1. AMCA Standard 500, based on 15 minute test of 48" x 48" louver. Provide louvers with water penetration and pressure drop no greater than specified louver, and with free area no less than specified louver.
2. Manufacturer shall provide test data under actual performance conditions to support the published performance data upon request by engineer or architect.

2.6 PREFABRICATED CURBS

A. General: Except where curbs are provided with equipment, provide prefabricated curbs for all roof mounted equipment.

B. Manufacturers:

1. Design Basis: Pace
2. Other Acceptable Manufacturers:
   a. Thycurb

C. Model for grease-laden exhaust fans: ES-2.

1. Coordinate to fit vibration isolation rail.

D. Coordinate with roofing Contractor. Exterior insulation, cants, flashing and counter flashing shall be furnished and installed under roofing work, Division 7.

E. Model: As required.

F. Roof Curbs

1. Roof curbs shall have a minimum height of 14” or as specified on the drawings, whichever is greater.
2. Roof curb insulation shall match the insulation requirements of the ductwork.
3. Roof curbs for kitchen exhaust ductwork shall include vented curb extension similar to Greenheck model VCE.

2.7 ACOUSTICAL PERFORMANCE SPECIFICATIONS - GENERAL

A. It is the intent of this Specification that noise levels due to air conditioning and/or ventilating equipment, ducts, grilles and registers, diffusers and air light fixtures, will permit attaining sound pressure levels in occupied spaces conforming to the following NC curves as explained in the ASHRAE Guide and Data Book.

Classrooms	NC-30
Office and Conference Rooms	NC-35
High Air Change Laboratory	NC-50

B. Grilles, Registers, Diffusers

1. The maximum permissible sound power levels of air terminal devices when installed and operating per plans and specifications shall be as follows:

Maximum PWL re 10-12 Watts

Octave Band	NC-30	NC-35	NC-40
1	62	64	66
2	52	56	60
3	44	49	54
4	41	46	51
5	38	43	48
6	37	42	47
7	36	41	46
8	37	42	47

C. Sound Power Levels shall be tested in accordance with ASHRAE Standard 6=36-72.

2.8 BALANCING DAMPERS

A. At each main branch take-off and in such other locations where required to properly balance the low pressure system, furnish and install volume dampers of the opposed blade, multi-louvered type, which shall be operated by indicating quadrants and set screws, for adjusting the system.

B. Volume dampers shall be constructed as follows: Damper blades shall not be wider than 12",

shall be complete with heavy angle iron frames, connecting and operating links, brass trunnions, and bronze bearings. Dampers, unless otherwise noted, shall be fabricated with not less than No. 16 gauge sheet steel. Blades shall overlap and shall be provided with continuous stops on all four sides of dampers to prevent leakage. Blades shall be galvanized. Blades of dampers shall be set into a flat steel frame with frame securely bolted to the duct. All dampers shall be fitted with a hexagonal brass spindle which shall extend through the exterior of duct and be fitted with an indicating self-locking regulator. Regulator shall be similar to Ventlok 641 or approved equal. All hardware shall be Ventlock or approved equal. For insulated ductwork provide No. 644 self-locking regulator as made by Ventlok or approved equal.

C. Maximum of two blades without a frame: Over two blades, use a manufactured 16 gauge galvanized stiffened, opposed blade damper in a 14 gauge galvanized steel frame. All hardware shall be galvanized except bronze iolite bearings; Pottorff Model MD-42 or approved equal.

D. All automatic dampers shall be furnished as a part of the automatic temperature control system by the automatic temperature control manufacturer. Install dampers and provide safeing in ductwork for automatic dampers smaller than duct size.

E. Movable splitter dampers shall be provided at each and every supply take-off and wherever else indicated. Dampers shall be airfoil, double-wall type. Splitter damper assembly shall be Ventlok 603 Ball Joint Bracket and 600 Blade Bracket or approved equal. All hardware shall be Ventlok or approved equal. Blades to be spot welded or pivoted to shafts. Elevated regulators shall be provided for insulated ductwork.

F. For stainless steel and aluminum ductwork provide dampers of same material as ductwork.

G. All dampers shall be made accessible from building construction. Access doors in building structure shall be furnished or provided as herein before specified.

H. Maximum pressure drop in full open position (@3000 fpm): 0.55

I. Maximum leakage: 32 cfm/sf at 4” W.C.

J. Provide cable operated dampers for all balancing dampers located above hard/inaccessible ceilings. Manufactured by Young Regulator or approved equal. Termination options are subject to Architect’s approval.

2.9 FIRE DAMPERS

A. Manufacturers:

1. Design Basis: Ruskin
2. Other Acceptable Manufacturers:
   a. Prefco
   b. Air Balance
   c. Safe-Air
   d. United Air
   e. United Sheetmetal
   f. National Controlled Air
   g. Air Control Products

h. Greenheck

B. Rating: UL555 dynamic 1-½ hours (2 hour wall), or 3 hours (3 or 4 hour wall), UL555S Class II leakage rated. Match construction penetrated. FM approved.

C. Size: Metal-to-metal for lined and unlined ducts.

D. Fusible link only. Use Type B "Top Hat" wherever possible.

E. Clearly indicate damper location on shop drawings. Provide access doors in the ducts and furnish access doors or panels at building construction at each damper of sufficient size and type to permit inspection and replacement of linkage. Assume responsibility to coordinate all locations of duct access doors with the General Contractor to conform with whatever architectural openings may be necessary and furnish access doors or panels in building construction. Provide shop drawings indicating location of access panels or doors for Architect's approval.

F. It is the intention of these plans and specifications to be complete. However, it is the responsibility of this Division, as being completely cognizant of local regulations, to determine where fire dampers are required and to advise the Architect prior to bid as to any discrepancies or questions in the plans or specifications.

G. Fire dampers shall be enclosed in integral UL/FM approved sleeve of fourteen gauge metal set and grouted into fire partitions. Sleeve shall be secured at both sides of fire partitions with 1-1/2 x 1-1/2 x 1/4 ga. mounting angles secured to sleeves only. Provide duct breakaway connections, see detail on drawings. Sleeves shall be continuously welded with the transverse joint sealed. Flanged duct/sleeve connection shall be UL listed.

H. Dampers shall be steel plate, mounted to turn freely, in steelplate frame inserted in duct. Dampers shall be proportioned and weighted to close at once, if released from link with spring catches to hold closed, until manually reset. Dampers and frames to have suitable eyes, standard fusible-links, normally holding them open, but releasing upon contact with fire. Damper blades shall be mounted on corrosion resisting bearings. Damper shall close by gravity, moving with the air stream to full closed position against one-eighth (1/8) inch angle stop. Steel spring catch shall hold damper closed. Radius arm on shaft shall show position of damper. Submit details for approval. Dampers shall be outside of air stream where space permits.

I. In stainless steel ductwork, provide stainless steel construction fire dampers similar to Fire Seal Model 119D.

2.10 FIRE/SMOKE DAMPERS AND DAMPER OPERATORS

A. Manufacturers:

1. Design Basis: Ruskin
2. Other Acceptable Manufacturers:
   a. National Controlled Air
   b. Johnson Controls
   c. Safe Air
   d. Prefco

e. Air Balance
f. Greenheck

B. Fire Damper Rating: UL Standard 555 Dynamic, 1-½ hour or 3 hours. FM approved.

C. Smoke Damper Rating: UL Standard 555S, Class II.

D. Each combination fire/smoke damper shall be 1-1/2 or 3 hour fire rated under UL Standard 555, and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class 2 (10 cfm/ft. at 1" w.g.).

E. Jackshaft penetrations shall be provided with a factory installed shaft seal, field sealing of the shaft is not acceptable.

F. Damper Assembly:

1. Type: 120 volt.
2. Listing: UL 555S, UL555.
3. Rating: Match wall rating.
4. Failure Position: Fail closed.
5. Fire closure device: Electric resettable link.
6. Blade: Air foil.
7. Seals: Mechanically fastened, rated up to 450°F.
8. Smoke Detector: Duct mounted within 4’ of damper. Activation of detector shall close damper and alarm fire alarm system.

G. Clearly indicate damper location on shop drawings. Provide access doors in the ducts and furnish access doors or panels at building construction at each damper of sufficient size and type to permit inspection and replacement of linkage. Assume responsibility to coordinate all locations of duct access doors with the General Contractor to conform with whatever architectural openings may be necessary and furnish access doors or panels in building construction. Provide shop drawings indicating location of access panels or doors for Architect’s approval.

H. Where part of Smoke Control System.

1. Provide end switch for positive indication of damper position.
2. Provide means to re-open damper remotely in the event thermal link trips. Allow for re-open up to elevated rating of 350°F, after which the elevated temperature high-limit override shall close the damper.

I. Combination fire/smoke dampers shall meet or exceed the following specifications. Frame shall be a minimum of 16 gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. The blades shall be airfoil shaped double skin construction with 14 gage equivalent thickness. Blade edge seals shall be silicone rubber designed to withstand 450˚F and jamb seals shall be stainless steel flexible metal compression type. Blade action

must be parallel blade or opposed as required.

J. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and 2000 fpm air velocity in the open position.

K. In addition to the leakage ratings already specified herein, the combination fire smoke dampers and their operators shall be qualified under UL555S to an elevated temperature of 250˚F, 350˚F, or 450˚F depending upon the operator. Appropriate electric operators shall be installed by the damper manufacturer at time of damper fabrication. Damper and operator shall be supplied as a single entity which meets all applicable UL555 and UL555S qualifications for both dampers and operators. Manufacturer shall provide factory assembled sleeve of 16" minimum length (contractor to verify requirement). Sleeve shall be 20 gage for dampers through 36" x 48" and 18 gage above 36" x 48". Sleeve shall be continuously welded or sealed and the transverse joint shall be sealed. Flanged duct sleeve connection shall be UL approved. Damper and operator assembly shall be factory cycled 10 times to assure operation.

L. Each combination fire/smoke damper shall be equipped with a UL Classified Firestat equal to Ruskin model TS150. Firestat shall electrically and mechanically lock damper in a closed position when duct temperatures exceed 212˚F and still allow appropriate authority to override Firestat and operate damper as may be required for smoke control functions. Damper must be operable while temperature is above 250˚F. Firestat package shall include two damper position indicator switches linked directly to damper blade to provide capability of remotely indicating damper position. One switch shall close when damper is fully open; the other switch shall close when the damper is fully closed. Firestat and position indicator switches shall be capable of interfacing electrically with smoke detectors, building fire alarm systems, and remote indicating/control stations. Provide damper test switch and remote annunciation indicator. Dampers shall be Ruskin Model FSD36 with TS150 Firestat package.

M. Provide 3-function actuators where dampers are used to modulate air flow during normal operation.

1. Fire function
2. Smoke function
3. Modulating position control function

2.11 SMOKE DAMPERS

A. Manufacturers:

1. Design Basis: Ruskin
2. Other Acceptable Manufacturers:
   a. Air Balance
   b. Greenheck
   c. Johnson Controls
   d. National Controlled Air
   e. Pottorff
   f. Prefco
   g. Safe Air

B. Smoke Damper Rating: UL Standard 555S, Class II.

C. Each smoke damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in Smoke Control Systems under the latest version of UL555S, and shall bear a UL label attesting to same, as (Class II Rating). Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers required by this specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class II (10 cfm/ft. at 1" w.g.).

D. Operator:

1. Type: 120 volt.
2. Listing: UL Smoke Damper Operator Label.
3. Failure Position:
   a. Smoke control system dampers: As shown on plans.
   b. Others: Closed
4. Smoke Detector: Duct mounted within 4' of damper. Activation of detector shall close damper and alarm fire alarm system.

E. Blade: Air foil.

F. Seals: Steel.

G. Clearly indicate damper location on shop drawings. Provide access doors in the ducts and furnish access doors or panels at building construction at each damper of sufficient size and type to permit inspection and replacement of linkage. Assume responsibility to coordinate all locations of duct access doors with the General Contractor to conform with whatever architectural openings may be necessary and furnish access doors or panels in building construction. Provide shop drawings indicating location of access panels or doors for Architect's approval.

H. Where part of smoke control system:

1. Provide end switches for positive indication of damper position, open and closed.

I. Furnish and install at locations indicated on plans, or as described in schedules, or as required by applicable codes, smoke dampers meeting or exceeding the following specifications. Frame shall be aluminum of 16 gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement. The blades shall be single skin 16 gage minimum galvanized with three longitudinal grooves for reinforcement. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450˚F and jamb seal shall be stainless steel flexible metal compression type.

J. As part of the UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and 3500 fpm air velocity in the open position for normal operation.

K. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350˚F. Electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity which meets all applicable UL555S qualifications for both dampers and actuators. Factory supplied caulked sleeve shall be 20 gage for dampers through

84" wide and 18 gage above 84" wide. Damper and actuator assembly shall be factory cycled 10 times to assure operation. Dampers shall be Ruskin Model SD36 or approved equal.

L. Each smoke damper shall be equipped with Ruskin SP100 Switch Package or equal. The Switch Package shall include two position indicator switches linked directly to the damper blade to provide the capability of remotely indicating damper blade position.

M. Provide 3-function actuators where dampers are used to modulate air flow during normal operation.

1. Fire function
2. Smoke function
3. Modulating position control function

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESSORIES

A. Install fire, smoke and ceiling dampers in accordance with manufacturer's instructions and the latest version of the Fire, Smoke and Radiation Damper Guide for HVAC Systems, published by SMACNA.

B. Use HIGH PRESSURE flexible duct where shown upstream of VAV boxes.

C. Notify fire alarm provider of smoke damper control requirements and fire alarm interlocks.

D. Install flexible ductwork without tight bends and free of kinks.

1. Flexible ductwork shall not exceed 6' in length.
2. Flexible ductwork shall be installed with a "minimum length of straight duct" upstream of the diffuser neck inlet. "A minimum length" shall mean a length equal to three (3) duct diameters. "Straight duct" shall mean the center-line of the duct shall be aligned with a line perpendicular to the plane of the diffuser neck opening at the center point of the opening.
3. Conform to the detail on the drawings.

E. Install all dampers, including those furnished by control contractor.

1. Caulk damper frames to ductwork.
2. Make sure dampers are free to operate properly.
3. Install parallel blade mixing dampers to two streams impinge on each other to facilitate mixing.

F. Provide balance dampers at all branch take-off and where required to minimize balancing performed at diffuser face.

G. Louvers shall be made easily removable without impacting finishes where access is required to service and maintain equipment installed behind.

H. Provide all balance dampers as shown on plans and any additional dampers necessary to provide a balanced system meeting all sound requirements.

I. Fire and smoke dampers shall be provided with an approved means of access, large enough to permit inspection and maintenance. The access shall not reduce the fire-resistance rating of the assembly. Access point shall be permanently identified on the exterior by a label having letters not less than ½" in height reading: SMOKE DAMPER, FIRE DAMPER or FIRE SMOKE DAMPER.

END OF SECTION 233300

SECTION 233400 - FANS

PART 1 - GENERAL

1.1 QUALITY CONTROL

A. Provide fans with AMCA performance certification and label.

B. Grease exhaust fan shall comply with NFPA 96 and be UL listed.

1.2 MOTOR HORSEPOWER

A. Do not increase or decrease motor horsepower from that specified without written approval from Architect/Engineer. See Section 23 05 01.

1.3 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data including:

1. Performance
2. Size
3. Type
4. Options provided
5. Fan curves
6. Indicate Compliance with Section 1.1 where applicable.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL FANS (CLASS I)

A. Manufacturers:

1. Design Basis: As scheduled.
2. Acceptable Manufacturers:
   a. Greenheck
   b. Buffalo
   c. Trane

B. Furnish and install as shown on the plans non-power overloading centrifugal fans with airfoil blades in sizes 24 and larger and plate-type blades in sizes 22 and smaller. Fans shall be of the specified size, arrangement, class and capacity. Fans having outlet velocities greater than those shown will not be acceptable.

C. Housings of fans, Class I, having wheel diameters 36" and smaller shall be convertible for various directions of discharge. Side sheets shall be fastened to scroll sheets by means of a deep lockseam. Housing supports shall be of one-piece welded constructed. Housing for Class I fans, having wheel diameters over 36", shall have side sheets welded to scroll sheets. Housings shall be split into two or more sections with heavy flanges on each section for bolting together. Flanges joints shall be gasketed for air-tightness. Sealer shall be applied to joints

between housing, inlet and housing support to prevent air leakage. The cutoff shall be of the rolled slope type and shall be wider and closer to the shaft at the suction side, then the drive side, for single width fans. Inlet collars on all sizes of single width fans shall extend beyond the fan housing to provide a continuous duct connection. Inlet collars on convertible housings shall be round and on nonconvertible housing shall be square. Both inlet and discharge duct collars shall be drilled or punched at uniform intervals. Inlet cones shall be spun or die-formed to provide smooth air flow into the wheel with minimum shock and turbulence.

D. Fans wheels shall be constructed of twelve deep airfoil blades, plate type blade in sizes 22 and smaller, backward inclined from the direction of rotation. Blades shall be securely welded to the spun rim and hub plate. Hubs shall be of close grined cast iron, securely riveted to the hub plate. All wheels shall be carefully trued after assembly and shall be carefully trued after assembly and shall be dynamically balanced.

E. Fan shafts shall be of SAE 1040 hot rolled steel, accurately turned, ground and polished. Close tolerances shall be maintained where shaft makes contact with bearings and fan wheel hub. All fans shall have adjustable belt and drives and shall be driven by a minimum of two belts.

F. Fans shall be equipped with precision anti-friction extra heavy duty bearings of the self-aligning, grease-packed, pillow block type having a grease seal that will prevent loss of lubricant and exclude dirt from the bearings. Lubrication fittings shall be provided on exterior of cabinet or housing. Average bearing life shall be min. 200,000 hours.

G. All fans shall be given a bonding coat before painting. After the cleaning and surface conditioning process, but before assembly, parts shall be spray painted with one coat of grey primer-finisher. A second coat of the same paint shall be applied to the exterior and all accessible interior surfaces after the fan is assembled. Shafts shall have a rust-preventive coating.

H. Fan ratings shall be based upon tests performed in strict accordance with the test code adopted jointly by the Air Moving and Conditioning Association and the American Society of Heating, Refrigeration and Air Conditioning Engineers. Each fan shall carry, near the manufacturer's nameplate, the seal authorized by AMCA indicating that ratings are certified. Fans not bearing this seal will not be acceptable.

I. Fans shall be as scheduled on the Drawings.

J. Provide 2" wire mesh inlet screens with each fan.

2.2 IN-LINE CENTRIFUGAL FAN

A. Manufacturers:

1. Design Basis: As scheduled
2. Acceptable Manufacturers:
   a. Greenheck
   b. Cook
   c. Trane
   d. Aerovent
   e. Carrier
   f. Jenn Air

g. Penn
h. American Coolair
i. Powerline
j. Twin City
k. Carnes

B. Cabinet: Steel, insulated, baked enamel finish with access panel.

C. Wheel: Cast aluminum Airfoil, statically and dynamically balanced. Cast aluminum hub.

D. Bearings: Heavy duty pillow black in enclosed duct with external grease fittings.

E. Guards: Belt.

F. Drive: See Schedule.

G. The fans shall be the square shaped and of heavy gauge formed steel. One of the sides shall be hinged and shall support the entire drive assembly (motor only for direct drive fans) and wheel allowing the assembly to swing out for cleaning, inspection or service without dismantling the unit in any way.

H. For direct drive fans, the motor shall be isolated from the air stream by a motor enclosure and shall draw cooling air from outside the fan housing.

I. For belt drive fans, the motor shall be mounted on the hinged side exterior isolated from air stream. The belt and pillow block ball bearings shall be protected from air stream by an enclosure. The shaft shall be keyed to both the wheel and pulley.

J. The fan inlet shall be spun Venturi throat overlapped by a backward curved centrifugal wheel with spun cone for maximum performance.

K. Air and sound shall be A.M.C.A. certified.

L. Install fan with spring type vibration isolators, threaded rods and expansion shields.

2.3 UP-BLAST ROOF EXHAUSTER

A. Manufacturers:

1. Design Basis: As scheduled
2. Acceptable Manufacturers:
   a. Ammerman
   b. Carnes
   c. Cook
   d. Greenheck
   e. Hurricane
   f. Jenn Air
   g. Penn
   h. Powerline

B. Features:

1. Spun aluminum housing.
2. Outside air motor cooling.
3. Grease trough.
4. Internal rubber vibration eliminators.
5. UL listed for grease laden air where noted on drawings.

C. Accessories:

1. Bird screen.

D. Provide factory fabricated curb of height required by local code.

PART 3 - EXECUTION

3.1 NOISE AND VIBRATION

A. Insure that fans are properly supported on vibration isolators. Reference Section 23 05 48 for Vibration Isolation Requirements.

B. Insure that flexible duct connections are properly made.

C. Check fan for improper balance and have fan re-balanced if necessary.

D. Check for proper rotation.

E. Check for unusual noise or vibration and correct as necessary.

3.2 ACCESS

A. Provide for proper access to all parts of fan needing inspection or service with access doors in fan or ductwork.

3.3 INSTALLATION

A. Install units level and plumb.

B. Provide necessary auxiliary supporting steel.

C. Mount motor and drives so belts run true.

D. Provide necessary lubrication.

E. Provide flexible duct connections on inlet and discharge.

F. Provide 460v/120v transfer to serve controls and convenience outlet at all 460v fans.

G. Provide unfused disconnect of suitable capacity. Disconnect shall be weatherproof where installed outside or in a location subject to wetness.

H. Provide vibration isolators as recommended by manufacturer and other sections of this specification.

I. Provide a hinged base at all up-blast fans.

3.4 CURBS

A. Provide necessary dimensions and details so roof opening can be provided at the proper time.

B. Coordinate delivery of curb with roofing contractor so project is not delayed.

C. Provide vented roof curbs for all kitchen exhaust penetrations through roof.

D. Provide a weatherproof installation:

1. Seal all joints including, but not limited to:
   a. Unit and curb.
   b. Unit and ducts.

END OF SECTION 233400

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable and constant volume terminal units.

B. Variable volume regulators.

C. Integral heating coils.

D. Integral damper motor operators.

E. Integral controls.

F. Dual duct air mixing boxes.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 09 00 – Building Automation and Automatic Temperature Control Systems: Thermostats and control components.

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. UL 181 - Factory-Made Air Ducts and Connectors.

C. ARI 880 - Air Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals.

D. UL - Shutoff terminal must be UL listed as a Room Air Terminal.

E. ASTM A 527 (Steel Sheet, Zinc Coated Galvanized)

1.4 SUBMITTALS

A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.

B. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and radiated sound power levels (2nd through 7th octave bands) at design maximum operating conditions. Also submit Radiated Sound NC values.

Shall be calculated at design conditions with the following path attenuation credits:

CORRECTION TO OCTAVE BAND SOUND POWER VALUE	2	3	4	5	6	7
Env Adj	-3	-2	-1	-1-	-1	-1
Mineral Fiber Ceiling Tile	-9	-10	-12	-14	-15	-15
Space Effect Factor	-10	-11	-12	-13	-13	-14

This transfer function represents modeling assumptions based on ARI 885-90.

C. Submit manufacturer's installation instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years experience.

1.6 WARRANTY

A. Provide one year manufacturer's parts warranty.

PART 2 - PRODUCTS

2.1 SINGLE DUCT CONSTANT (C.A.V.) AND VARIABLE (V.A.V.) VOLUME AIR TERMINAL UNITS

A. Manufacturers:

1. Design Basis: Titus
2. Other Acceptable Manufacturers:
   a. Anemostat
   b. Metal Aire
   c. Enviro-Tec
   d. Carnes

B. Sound Criteria:

1. Conform to ARI 880 performance test standard.
   a. Sound levels may be attained using attenuators, but pressure drop of attenuator must be included as part of unit pressure drop.
   b. Units may discharge into lined or fiberglass ductwork, credit for which cannot be claimed in sound criteria.

C. Duct Connections:

1. Duct connections shown on drawing are minimum.
2. Units with larger connections may be used to meet pressure or sound requirements.
3. Flexible duct shall be same size as unit connection.

D. Construction:

1. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with a non-porous, sealed liner which complies with UL 181 and NFPA 90A. Insulation shall be 4 lb. density. All cut edges must be sealed from the airstream using mechanically bonded metal barrier strips. Liners made of Mylar, Tedlar, Silane or woven fiberglass cloth are not acceptable. Insulation shall be equivalent to TITUS Steri-Loc or double wall lining is acceptable.
2. The discharge connection shall be slip and drive construction for attachment to metal ductwork.
3. Maximum leakage not exceeding 1% design flow.
4. The damper shall be heavy gauge steel with shaft rotating in Delrin® self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values.
5. Actuators shall be capable of supplying at least 35-inch lbs. of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork.

E. At an inlet velocity of 2000 fpm, the minimum static pressure required to operate any terminal size shall not exceed 0.13-inch wg for the basic terminal.

F. Heating Coils:

1. Refer to Section 23 82 16 – Air Coils.
2. Proof of flow shall be by sail switch.
3. Electric Heating Coils (SCR)
   a. Electric coils shall be supplied and installed on the terminal by the terminal manufacturer.
   b. Coils shall be ETL listed.
   c. Proportional, modulating electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be ETL listed. Coils shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5 inches to prevent damage to elements during shipping and installation. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3.5 inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step.
   d. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices
   e. Electric coils shall contain a primary automatic reset thermal cutout, a secondary manual reset thermal cutout, proportional electronic airflow sensor for proof of flow, and line terminal block.
   f. The proportional electronic airflow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available airflow. The heaters shall deliver maximum heating when needed with normal minimum airflow, reduce heating with lower than minimum airflow and stop heating with no airflow. Unit shall include an integral door interlock type disconnect switch

which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable.

g. All individual components shall be UL listed or recognized.

h. Heaters shall be equipped with a proportional SCR controller to modulate the heater load according to the temperature control signal. The electronic controller shall be compatible with the following input signals:

1) Variable voltage signal 0-10 VDC
2) Pulse width modulation AC or DC

G. Control:

1. Electronic, using velocity sensor, with compensation or correction for distorted flow at inlet.
2. Maximum and minimum volume controls shall be:
   a. Factory set (with allowance for altitude of project).
   b. accurate within 10%.
3. Units shall be normally open with reversing relay for use with direct acting thermostat.
4. Provide electric motor. Coordinate voltage with controls contractor, if 120V, provide integral disconnect switch in VAV box controller and transformer.
5. Coordinate spring range with Automatic Temperature Control Section.
6. Coordinate controls on CAV and VAV units with control contractor.
7. Provide CFM output to BMS.

2.2 SOUND PERFORMANCE

A. Terminal units shall not exceed the following sound criteria.

Permitted Radiated Sound Performance				
Flow	Air Pressure Drop			
	.5”	1.0”	1.5”	2”
100	11	15	17	18
200	15	21	23	25
300	22	28	25	28
400	21	27	30	33
500	22	24	27	29
600	23	27	27	29
700	22	25	29	31
800	19	23	26	29
1000	22	28	31	34
1400	22	28	28	30
1800	25	27	29	33

Permitted Discharge Sound Performance				
Flow	Air Pressure Drop			
	.5”	1.0”	1.5”	2”
100	28	29	30	31
200	29	31	34	35
300	29	33	30	33
400	25	30	34	35

500	25	29	31	34
600	26	30	34	36
700	29	33	35	38
800	25	29	30	31
1000	29	31	33	34
1400	26	30	26	29
1800	29	25	28	30

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION 233600

SECTION 233700 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 CEILING CONSTRUCTION

A. Provide products compatible with ceiling construction.

1.2 SUBMITTALS

A. Submit catalog data including throw, sound, pressure drop, physical dimensions and color.

1.3 INDUSTRY STANDARDS

A. Provide products tested in accordance with ASHRAE 70-1991 150 Standard 5219, 150 Standard 3741.

PART 2 - PRODUCTS

2.1 GRILLES AND RECTANGULAR DIFFUSERS

A. Manufacturers:

1. Design Basis: Titus
2. Other Acceptable Manufacturers:
   a. Carnes
   b. Anemostat
   c. Metal Aire

B. Material: Steel or aluminum except:

1. Where noted otherwise.
2. Where required otherwise for fire rating.
3. Grilles and diffusers in locker rooms, showers and toilet rooms to be aluminum.

C. Finish: Baked enamel with color selected by Architect.

D. Refer to Drawings for required performance.

E. Match frame and border types to ceiling system.

2.2 SQUARE CEILING DIFFUSERS:

A. Manufacturers:

1. Design Basis: Titus OMNI
2. Other Acceptable Manufacturers:
   a. Carnes Series SK or SE
   b. Krueger Series S

c. Metal Aire Series 5000
d. Anemostat
e. EH Price Model AMD

B. Material: Steel or aluminum, louvered face furnished with frame type appropriate to installation, except:

1. Where noted otherwise.
2. Where required otherwise for fire rating.
3. Grilles and diffusers in locker rooms, showers and toilet rooms to be aluminum.

C. Finish: Baked enamel except where noted, color by Architect.

D. Louver cones shall be one-piece construction with no corner joints.

E. Directional blow pattern as shown on the drawings and/or as scheduled.

F. Refer to the Drawings for required performance.

G. Match frame and border types to ceiling system.

2.3 SQUARE CEILING RETURN/EXHAUST GRILLES:

A. Manufacturers:

1. Design Basis: Titus 350
2. Other Acceptable Manufacturers:
   a. Carnes
   b. Krueger
   c. Metal Aire
   d. Anemostat
   e. Price

B. Material: Steel or aluminum perforated face furnished with frame type appropriate to installation, except:

1. Where noted otherwise.
2. Where required otherwise for fire rating.
3. Grilles and diffusers in locker rooms, showers, kitchens, concessions, and toilet rooms to be aluminum.

C. Material: Steel or aluminum except:

1. Where noted otherwise.
2. Where required otherwise for fire rating.
3. Grilles and diffusers in locker rooms, showers and toilet rooms to be aluminum.

D. Finish: Baked enamel except where noted, color by Architect.

E. Fixed blade (0°, 45°) core return and exhaust registers and grilles.

F. Opposed blade volume control damper return registers, operable from face.

G. Register and grille sizes as shown on drawings and/or as scheduled.

H. Screw holes on surface counter sunk to accept recessed type screws.

I. Refer to the Drawings for required performance.

J. Provide a 6” deep plenum at each register. The inside of the plenum shall be painted flat black.

K. Refer to the Drawings for required performance.

L. Match frame and border types to ceiling system.

2.4 SIDE –WALL REGISTERS AND GRILLES:

A. Manufacturers:

1. Design Basis: Titus series 300(supply) and series 350(return/exhaust)
2. Other Acceptable Manufacturers:
   a. Carnes model R series
   b. Krueger series 880
   c. Metal Aire series V4000 or H4000
   d. Anemostat
   e. EH Price model NM22S/T or C22S/3

B. Material: Steel or aluminum except:

1. Where noted otherwise.
2. Where required otherwise for fire rating.
3. Grilles and diffusers in locker rooms, showers and toilet rooms to be aluminum.

C. Finish: Baked enamel except where noted, color by Architect.

D. Double deflection type blade supply registers and supply grilles allow deflection adjustment in all direction.

E. Opposed blade volume control damper supply registers, operable from face.

F. Fixed blade (0°, 45°) core return and exhaust registers and grilles.

G. Opposed blade volume control damper return registers, operable from face.

H. Register and grille sizes as shown on drawings and/or as scheduled.

I. Screw holes on surface counter sunk to accept recessed type screws.

J. Refer to the Drawings for required performance.

2.5 HEPA DUCTED CEILING MODULE

A. Manufacturers:

1. Design Basis: AAF Flanders
2. Other acceptable manufacturers:
   a. Approved manufacturers that can meet the specifications below and capacities on the drawings.

B. Quality:

1. The manufacturer shall have an ISO 9000 or ASME NQA-1 quality based system at the manufacturing facility. The manufacturer shall make available documentation showing independent third party certification or acceptable audit approvals and adherence to these systems.

2. If requested, manufacturer shall make available a copy of their Corporate Quality Manual and references from clients of similar sized projects or scope within the last 5 years

C. Testing:

1. Terminal Ducted Air Filter Modules shall be individually factory-tested and certified.\

2. Each hood shall have a serial number allowing for full traceability. Each hood shall be individually serialized and traceable to the specified leak test procedure.

3. Certification of each HEPA filter in accordance with applicable IES Standard(s) and specifications indicated below. Each filter shall have permanent label indicating filter type, model number and size designator, unique serial number allowing for full traceability, air resistance, airflow, target efficiency, target pressure drop and test date, average penetration and probe test certification.

4. All cleanroom style filters are tested at 90 FPM, +/- 10% and are based on filter media area. For example, an actual 24” x 24” filter has an area of 4 ft^2, thus a tested flow rate of 400 CFM. The maximum initial pressure drop per overall efficiency rating is as follows:

Pack Depth	Max. initial ΔP
35mm	0.29” w.g.
50mm	0.19” w.g.

D. Construction

1. Fluid seal housing shall be constructed of 16 gauge 304 series stainless steel with joints and seams fully welded. The housing is available to be white powder coated as an option. The assembly shall be able to withstand a positive or negative pressure of 3" w.g.

2. Fluid seal housing shall be constructed in a manner that includes a completely sealed integral knife edge to mate with the fluid seal trough on the filter and form a leak proof seal between housing and filter frame. Knife edge to be formed by bending side wall of housing and forming a sealing edge. Tack welding and caulked knife edges with potential leak points are not acceptable. Housing side wall shall be equipped with swirled factory predrilled hole to accept pop rivets for connection of the perimeter trim.

3. Housing shall have round or square duct connection with crimped inlet collar fully seal welded into the hood body, size and type as shown on the Drawings or data schedules/data sheets. If needed, the unit can be specified with a side inlet of the same material as the hood body. The side inlet shall be square or rectangular and be continuously welded to housing. Intermittently welded and caulked in place inlet collars are not acceptable.

4. Provide factory installed ESD Sliding Damper on air leaving side of inlet collar. Butterfly and opposed blade dampers are not acceptable. The damper shall be operated by mechanical rod linkage and rack and pinion gear assembly. Rotary flex cable actuators are not acceptable. Damper shall provide 100% shut off capability. Damper shall fully open and close with a minimum of ten full revolutions of the assembly to allow for fine tuning of airflow. Damper control mechanism shall be operable from room side. The damper assembly shall be skip welded in place including any brackets required to ensure no leaks of the pressure boundary areas. The damper shall be capable of delivering velocity uniformity within a standard deviation of +/- 5% while producing a resistance to airflow less than 0.15 “w.g. The damper assembly when installed shall require no impingement plate or obstructions within the collar.

5. The housing shall have a validated aerosol injection system with a port located in filter sealing surface of housing to inject an aerosol challenge into the unit ESD Damper assembly via an aerosol dispersion manifold, accessible from air outlet side. The manifold system is designed to introduce test aerosol at the hood inlet for filter penetration testing. Aerosol distribution tubing and dispersion manifold shall be constructed of the same material as the hood’s knife edge. Flexible plastic tubing is not acceptable. Aerosol uniformity upstream of the damper shall deviate no more than +/- 10% of the standard deviation when measured via traverse damper readings. Reports should be provided. The assembly shall have a 3/8” female NPT fitting as standard. Optionally a 3/8" chrome plated “Colder” quick disconnect fitting with a “BUNA-N” ring seals and snap-in barbed connector.

6. There shall be a labeled test port, accessible from the air outlet side, to measure static pressure and upstream aerosol concentration at filter inlet upstream of filter but downstream of damper. The assembly shall have a 3/8” female NPT fitting as standard. Optionally a 3/8" chrome plated “Colder” quick disconnect fitting with “BUN-A” ring seals and snap-in barbed connector.

7. The unit shall have hanging tabs on the top edge of housing at each of the 4 corners. They shall be plug welded to the housing. Other optional mounting methods are Mounting Pads and Clean Ceiling Angle either at two or three inches from the bottom of the unit. Pop riveted connections are not acceptable.

8. Housings shall include filter alignment tabs welded in place to center the filter in the housing.

9. Housing shall have four captive retainers to secure gel seal filters with knife-edge seal between housing and fluid-filled channel around perimeter of filter frame.

10. If required, the entire housing shall be insulated at the factory with two inch thick, foil-backed, fiberglass insulation. Armoflex foam is an option to the fiberglass insulation.

Insulation shall comply with requirements of ASTM E84, NFPA 255 and UL 723. Tape seams with aluminum foil backed tape

11. Grille shall be 20 gauge 316L stainless steel with No. 3 finish room side, perforated to provide 40% free area. The grille shall flush and be installed with four 3/8" acorn nuts as standard. Optionally the grille shall be flush-mounted with Type 316L stainless steel removable hinges on long side of housing and two quarter turn stainless steel hand operated fasteners, which do not require use of hand tools. Other options include 40% painted grille, an 18 gauge swirl stainless steel diffuser with No. 4 finish, a painted swirl stainless steel diffuser. The perforated grille is to have a hemmed edge for rigidity.

12. The perimeter trim shall be non-removable unless field installed trim for hard/plaster ceilings is specified. Trim shall be 1/2" permanent or 1/2" or 1-1/2" wide field installed trim constructed of minimum 18 gauge type 304 or 316L stainless steel with No. 3 or No. 4 finish on surfaces exposed the room.

13. All hoods shall be visually inspected for pinholes, porosity, indentations or inclusions exceeding 10% base metal; lack of filler material, excessive weld build up and cold shunts. Hoods shall be leak tested per manufacturer's quality control procedure. QC procedure to be submitted for approval with product submissions. The hood knife edge shall be sealed off with a jig and the hood plenum area will be pressurized to 3.0" w.g. All exterior hood body weld, all welds in the filter sealing surface area and all penetrations such as damper control, static pressure and aerosol ports shall be bubble tested for leaks. All hoods must meet a zero leak criteria.

E. HEPA Filters

1. Filters construction shall be extruded anodized aluminum for use in Open Plenum, Ducted Terminal, or Fan Powered Systems. Frame style will be determined by filter application. The term "HEPA" shall be used generically to describe all high-efficiency filters that meet the following specifications. If possible, the filter and housing shall be from the same manufacturer to ensure form, fit, and function are maximized.

2. Construction Criteria;

   a. The filter shall be constructed in accordance with the recommended construction requirements of IEST-RP-CC001, latest version.

   b. The media shall be of eFRM (FlouroResin) technology and shall be produced by the filter manufacturer to ensure quality requirements and traceability are maintained. eFRM media shall consist of two membrane layers supported on each side with spun bonded synthetic scrim to eliminate media damage; glass fiber media is not allowed. The pleats shall be equally spaced using polyolefin hot melt glue beads. eFRM media shall be compatible with industry standard testing methodologies using 4cS PAO and shall have equal or better tolerance for PAO compared to conventional fiberglass HEPA media. Nominal media pack depth shall be either 35mm or 50mm deep.

   c. The media pack shall be affixed permanently to the filter frame assembly by means of a solid, continuous, fire retardant, phosphorous free polyurethane sealant, forming a leak free bond between the filter pack and filter frame. The

sealant will be uniform off-white in color; will not exhibit any form of leaching, and no more than ¼" of wicking into the media. The sealant will be qualified at incoming inspection as well as point of dispensing to ensure homogenization and adequate curing and adhesion properties.

d. The filter frame shall be of minimum of 0.060" thick webbing anodized extruded aluminum Filter Frame shall be designed for use in Fluid Seal systems. The filter frame shall have a perpendicularity specification of no more than 1% to ensure tight miter corners and a leak free design. Corners must contain no cracks or uneven areas.

e. Fluid Seal system filters shall have:

3. A continuous trough around the perimeter of the filter with continuous, integral indication of acceptable fluid seal fill level. The fluid seal trough shall be filled at the factory.

4. Filter fluid seal must be comprised of a two component, slow-cured, polysiloxane elastomeric sealant and be self-leveling.

a. Fluid seal material shall be characterized for all salient mechanical, physical, and chemical properties such as Hardness/Penetration, Tack, and Migration of free silicone (i.e. Blot Plot testing).

b. Fluid seal material shall be characterized for chemical resistance to known industry accepted decontamination agents, cleaning agents, and filter testing reagents.

c. Fluid seal material shall be tested for chemical compatibility to all materials in contact during manufacturing including gloves, tools, mixing equipment, dispensing equipment, and packaging materials, as well as potential airborne contaminants & poisons.

d. Fluid seal material shall demonstrate resistance to accelerated life cycle testing.

e. Fluid Seal shall withstand knife edge insertion to partial depth without complete depth cutting or full length splitting.

5. Each filter shall have a unique label indicating filter size, lot number, unique serial number, model number, tested efficiency, pressure drop at volumetric test airflow, and UL compliance.

6. Manufacturing shall take place in an ISO 7 cleanroom as determined by ISO 14644. Packaging shall be in a minimum ISO 6 cleanroom as determined by ISO 14644.

PART 3 – EXECUTION

3.1 GENERAL

A. Refer to architectural reflected ceiling plan for exact locations and ceiling types.

B. Install grilles, registers and diffusers as shown on drawings, in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that equipment complies with requirements and serve intended purposes.

C. Coordinate with other work as necessary to interface installation of equipment with other components of systems.

D. Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into diffuser neck and providing directional control of airflow.

E. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.

F. Seal connections between ductwork drops and diffusers/grilles airtight.

G. Blank off unused portion of linear slot diffusers and linear bar diffusers and grilles.

H. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

I. Where registers and/or grilles cannot be installed to avoid seeing above the ceiling, paint the above the ceiling in the area of the register and/or grille with flat black paint to reduce visibility.

J. In clean rooms caulk space between diffuser or grille and ceiling or wall to be air and watertight. User clear, non-hardening silicone sealant compatible with ceiling or wall surfaces. Sealant shall be resistant to microbiological growth.

K. Exposed mounting screws:

1. Use tamper proof screws in countersunk holes.
2. Point screws to match frame.

L. Fire Rated Ceilings:

1. Provide ceiling fire or fire/smoke damper that meets all applicable requirements of Section 23 33 00.
2. Provide insulation equivalent to ceiling construction above diffuser between ceiling opening and ceiling damper.

M. Install security type devices in accordance with manufacturer’s directions.

3.2 INSPECTION

A. Contractor shall examine location where this equipment is to be installed and determine space conditions and notify architect in writing of conditions detrimental to proper and timely completion of the Work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of equipment, energized with normal power source, test equipment to demonstrate compliance with requirement. When possible, field correct malfunctioning units, then, retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected. Refer to Testing and Balancing.

END OF SECTION 233700

SECTION 237400 - PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Package roof top unit.

B. Heat exchanger.

C. Refrigeration components.

D. Unit operating controls.

E. Roof curb.

F. Electrical power connections.

G. Operation and maintenance service.

1.2 RELATED SECTIONS

A. Section 23 05 13 – Motors and Starters.

B. Section 23 05 G Automation and Temperature Control Systems.

1.3 PERFORMANCE STANDARDS

A. ARI 370 - Sound Rating of Outdoor Unitary Equipment.

B. ANSI/NFPA 70-1990 - National Electric Code.

C. ANSI Z21.47 - Gas-Fired Central Furnaces (except Direct Vent Central Furnaces).

D. ASHRAE Standard #15.

E. EPA Clean Air Act.

F. ARI Standard 210, and bearing ARI certification.

G. Refer to all other Specification Sections, including, but not limited to, 23 05 13, 23 05 30, and 23 05 48.

1.4 REFERENCES

[Parentheses are indicators of which unit(s) the codes apply to, gas/electric (g/e), cooling with electric heat (c/e), heat pump (hp), or (all).]

A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems an Installation of Warm Air Heating and Air Conditioning Systems. (all)

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration. (all)

C. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard. (g/e, c/e above 135,000 btuh)

D. ARI 340 - Commercial and Industrial Unitary Heat pump Equipment. (hp above 135,000 btuh)

E. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment. (all)

F. ANSI/ASHRAE/IES 90 A and 90.1 - Energy Conservation in New Building Design Standard.

G. ANSI/UL 465 - Central Cooling Air Conditioners Standard for safety requirements. (g/e, c/e)

H. ANSI/UL 559 - Heat Pumps, Standard for safety requirements. (hp)

I. ARI 210/240 - Unitary Air-Conditioning Equipment and Air-Source Heat Pump Equipment. (all under 135,000 btuh)

J. ARI 270 - Sound Rating of Outdoor Unitary Equipment. (all below 135,000)

K. ANSI/NFPA 70-1990 - National Electric Code. (all)

L. ANSI Z21.47 - Gas-Fired Central Furnaces (except Direct Vent Central Furnaces). (g/e)

1.5 SUBMITTALS

A. Submit drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections.

B. Submit manufacturer’s installation instructions.

C. Submit manufacturer’s data, including:

1. Drawings showing overall dimensions of complete assembly, including curbs at specific location on roof for each unit.
2. Operating weights.
3. Equipment support requirements.
4. Sizes and locations of connections.
5. Accessories.
6. Auxiliary support requirements.
7. Unit installation shop drawings.

D. Coordinate with Installer of temperature control work. Prepare wiring diagram showing connections to unit wiring to accomplish control sequence specified in Section 23 09 00.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit three (3) copies of operation and maintenance manuals to the engineer [after shop drawing review stamp has been applied to the product data].

B. Include manufacturer's descriptive literature, start-up and operating instructions, installation instructions, and maintenance procedures.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units from physical damage. Leave factory shipping covers in place until installation.

1.8 WARRANTY

A. Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.

B. Include one year service guarantee on the entire refrigeration cycle and its associated interlocks. This guarantee shall obligate the installer to service the equipment and attend to all legitimate service calls and make necessary repairs, alterations, additions, adding refrigerant charges, etc. for a period of one year without additional cost to the Owner. Compressors shall carry an additional four year parts warranty with the exclusion of replacement labor. Shop drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year service.

1.9 QUALITY ASSURANCE

A. Unit shall be designed to conform to ANSI/ASHRAE (American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers) 15 (latest edition), ASHRAE 62, and UL (Underwriters Laboratories) Standard 1995.

B. Unit shall be listed as a total package by ETL and ETL, Canada.

C. Roof curb shall be designed to NRCA (National Roofing Contractors Association) criteria per Bulletin B-1986.

D. Insulation and adhesive shall meet NFPA (National Fire Protection Association) 90A requirements for flame spread and smoke generation.

E. Unit shall be rated in accordance with AHRI 920 rating standard for direct expansion (DX) dedicated outdoor air systems (DOAS). AHRI 340/360 for packaged unitary equipment is not acceptable.

1.10 MAINTENANCE SERVICE

A. Furnish complete parts and labor service and maintenance of packaged roof top units for (1) year from Date of Substantial Completion by manufacturers' authorized service agency.

B. Provide preventive maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.

C. Include maintenance items as outlined in manufacturer's operating and maintenance data.

D. Contractor shall submit copy of service call work order or report and include description of work performed.

E. Manufacturer shall maintain a parts and service center in the city from which the units are purchased.

1.11 REGULATORY REQUIREMENTS

A. Units shall be U.L. listed and labeled, classified in accordance to ANSI Z21.47 for gas fired central furnaces, U.L. 465 for central cooling air conditioners, and U.L. 559 for Heat Pumps. Canadian units shall be CSA certified.

1.12 EXTRA MATERIALS

A. Provide one (1) set of pleated media filters equivalent to Farr 30-30 in 2" filters.

B. Furnish one (1) complete set of fan motor drive belts.

PART 2 - PRODUCTS

2.1 GENERAL

A. System Description

1. Outdoor roof curb electronically controlled, cooling/heating unit utilizing hermetic scroll compressors with crankcase heaters for cooling duty and electric resistance heaters for heating duty. Units shall discharge supply air as shown on contract drawings.

B. The unit shall be a packaged, factory-assembled dedicated outdoor air unit (DOAS) with direct expansion (DX) cooling and heat. The unit shall consist of all factory wiring with a single point power connection, refrigerant piping and charge (R-410A), operating oil charge, dual refrigerant circuits, and with a microprocessor-based control system. The unit shall, based on project requirements, include all special features necessary to provide fully conditioned ventilation air at neutral conditions to the building.

2.2 UNIT CABINET

A. Double wall design, constructed of G-90 galvanized steel, bonderized and pre-coated with a polyester pre-coat finish.

1. Top cover shall be a minimum of 18-gage sheet metal for D Cabinet and a minimum of 20-gage sheet metal for A, B, and C Cabinet, with 2.0-in. thick, closed cell foam insulation with an R-13 rating and a 24-gage sheet metal interior liner.

2. Access panels and doors shall be a minimum of 20-gage sheet metal with 2.0-in. thick, closed cell foam insulation with an R-13 rating with a 24-gage sheet metal interior liner. Access doors shall be equipped with stainless steel hinges and quarter turn, adjustable, draw tight cam-action latches.

3. Corner and center posts shall be 16 or 18-gage galvanized steel.

4. Base pans shall be 16 or 18-gage galvanized steel. All openings through the base pan shall have upturned flanges at least 0.5 inch in height.

5. Base pans shall be insulated with 0.375-in. thick closed cell foam insulation.

6. Condensate pan shall be 20-gage stainless steel insulated with closed cell neoprene insulation.

7. Base rail shall be double flanged 12-gage galvanized steel (16-gage for A cabinet) or welded closed section structural steel tubing.

8. Roof sections shall be sloped for proper drainage.

B. Unit casing shall be capable of withstanding 1000-hour salt spray exposure per ASTM (American Society for Testing and Material) B117 (scribed specimen).

C. Unit shall have insulated access doors, hinged for easy access to the controls compartment and all other areas requiring servicing. Each door shall seal against a triple-edge, co-extruded EPDM gasket to help prevent air and water leakage and for ease and safety during servicing.

D. Interior cabinet surfaces shall be lined with 24-gage galvanized steel.

E. Unit shall have a factory-installed, sloped condensate drain connection fabricated of stainless steel with welded corners and drain connection.

F. Unit shall be equipped with fittings in frame rails to facilitate overhead rigging.

G. Filters shall be accessible through a hinged access panel.

H. The outdoor air opening shall have a factory-provided hood with bird screen.

2.3 FANS

A. Indoor Evaporator Fans:

1. Direct drive plenum fan shall be provided and all axial and radial clearances must be equal to or greater than fan manufacturer's recommendations for full-rated fan performance and efficiency. Belt drive fans are not acceptable.

2. Base mounted and external rotor fans with electronic communication motors shall be statically and dynamically balanced at the factory as a single rotating assembly to a quality level of G=2.5 in accordance with DIN ISO 1940-1.

3. Fan Status Switch: The unit shall be equipped with a current sensing switch to provide proof of airflow.

B. Condenser Fans:

1. Fans shall be external rotor, direct-driven axial fans with a minimum 5 1/2-in. spun venturi for high efficiency and low noise, with formed and profiled blades.

2. The fan motor assembly shall be end mounted to a structurally rigid welded finger guard.

3. Fans shall discharge air vertically upward and the finger guard shall be powder coated.

4. Fans shall be statically and dynamically balanced as an assembly to a quality level of G=6.3 in accordance with DIN ISO 1940-1.

2.4 COMPRESSORS

A. Fully hermetic, scroll type compressors with overload protection and short cycle protection with minimum on and off cycle timers.

B. Compressor shall be installed in a compartment accessible through hinged access doors, isolated from the treated air stream.

C. Line voltage controls, operating controls, refrigerant circuit access points, refrigerant flow control devices and compressors shall be accessible from a single location behind opposed hinged access doors for ease of service.

D. Compressors shall be mounted on rubber in shear isolators and refrigerant lines to include loops to absorb reaction torque.

E. Reverse rotation protection shall be provided for all compressors.

F. Lead circuit compressor shall be variable capacity type, either digital (3-20 tons) or inverter (20+ tons). Digital compressors shall be capable of modulating from 20-100% of nominal compressor capacity. Inverter drive compressors shall be capable of modulating from 100% of nominal compressor capacity. All circuits with inverter compressors shall be equipped with minimum load control valve.

2.5 COILS

A. Standard evaporator coil shall have enhanced surface aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with brazed tube joints.

B. Evaporator coils shall be no less than six rows deep.

C. Standard condenser coil shall be microchannel heat exchanger (MCHX).

D. Coils shall be vendor certified for 650 psig prior to unit assembly; leak tested at 300 psig, with a final test at 475 psig.

2.6 REFRIGERANT COMPONENTS

A. Unit shall be equipped with dual refrigerant circuits, with each circuit containing:

1. Solid core filter drier.

2. Field-adjustable externally equalized thermostatic expansion valve.

3. Minimum load valve on any fixed speed or inverter drive compressor (hot gas bypass).

4. Service access ports.

5. Variable speed condenser fan for head pressure control. Fan cycling control is not acceptable.

2.7 FILTER SECTION

A. Filter section shall be supplied with 2-in. thick MERV-8 pleated media pre-filters and 4-in MERV-14 final filters.

B. Dirty Filter Status Switch: The manual reset filter status switch shall be a pressure differential switch and will indicate a dirty filter. The switch shall be factory installed.

2.8 CONTROLS AND SAFETIES

A. Microprocessor controller shall be factory mounted, wired, programmed and run tested. Field installed or field programmed controllers are not acceptable. Controller shall also feature:

1. BACnet, protocol capable.

2. Standalone operation capability with integral schedule and operational set point

3. Password protected control system with administrative passwords to prevent un-wanted control changes

4. Program archival and restore function to allow for saving and restoration of program modifications

5. User adjustable set points and settings to allow for adaptation to application needs

6. Alarm function with alarm history

7. Shall be compatible with the Equipment Touch or Equipment Touch app. Other interface devices are not acceptable.

B. Safeties:

1. Unit shall incorporate an electronic compressor lockout which provides optional reset capability should any of the following safety devices trip and shut off compressor:

a. Compressor lockout protection provided for either internal or external overload.
b. Low-pressure protection.
c. Freeze protection (evaporator coil).
d. High-pressure protection.
e. Loss of charge protection.
f. Condensate overflow protection

2. Supply-air sensor shall be located in the unit and shall be used for compressor stage and modulation control.

3. Unit shall be equipped with a supply fan status switch to protect the system in the event of a fan failure.

2.9 OPERATING CHARACTERISTICS

A. Unit shall be capable of starting and running at 115°F outdoor ambient air temperature.

B. Unit with standard controls will operate in cooling down to an outdoor ambient temperature of 55°F.

C. Units shall be equipped with a motorized two position outdoor air (OA) damper for 100% OA operation. Control and isolation dampers to have a leakage rate of less than 5 scfm per sq. ft. at 1 in. pressure differential.

2.10 ELECTRICAL REQUIREMENTS

A. All unit power wiring shall enter unit cabinet at a single location with a single power point connection.

B. All units shall include an electrical schematic, permanently installed on the control cabinet door.

C. Phase/Voltage Monitor: A factory-installed under-voltage and phase loss sensor shall stop the unit whenever voltage is too low, phases are out of sequence, or a phase is dropped. The unit will restart automatically within five minutes after the correct power is supplied.

D. A factory installed and wired variable speed drive shall be included on all OPD or TEFC fan motors.

E. Unit shall have a short circuit current rating (SCCR) of no less than 5kA.

F. Shall be factory-installed and externally mounted with a 115-v, 15 amp female GFI receptacle with hinged cover. The outlet shall be factory wired from a transformer powered by the load side of the disconnect and shall include a 15A breaker.

G. Shall be factory-installed, internally mounted rotary or externally mounted blade type disconnect that is UL registered. Non-fused switch shall provide unit power shutoff and shall be accessible from outside the unit. The switch shall provide power off lockout capability.

2.11 MOTORS

A. Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have either internal line break thermal and current overload protection or external current overload modules with compressor temperature sensors.

B. All condenser fan motors shall be totally enclosed air-over (IP54) with permanently lubricated ball bearings, class F insulation and manual reset overload protection.

C. All indoor-fan motors shall meet the standard efficiency requirements as established by the Energy Independence and Security Act of 2007 (EISA), effective December 10, 2010.

D. Standard indoor fan motors (except for EC motors) shall be open drip proof (ODP) design with optional totally enclosed fan cooled (TEFC) motors available.

E. ODP or TEFC fan motors shall be inverter duty

2.12 ELECTRIC HEAT

A. Electric resistance heaters shall be factory-installed, nichrome element type, open wire coils with 0.375-in. inside diameter, insulated with ceramic bushings, and include operating and safety controls. Coil ends shall be staked and welded to terminal screw slots.

B. Factory-installed electric heat shall have SCR (silicon controlled rectifier) control providing infinite capacity adjustment.

2.13 ADDITIONAL FEATURES

A. Airflow Monitor Control

1. Optional airflow monitor shall be factory installed to read the supply or supply and exhaust fans and provide a reading back to the unit controller. Unit control shall modulate the supply and exhaust fan to maintain the airflow set points.

B. Pressure Control:

1. Optional fan static pressure control shall be available for the supply or supply and exhaust fan. Control shall modulate the supply fan to maintain the supply duct pressure set point. Units with an exhaust fan will also include an building pressure transducer (factory supplied, field installed).

2. Unit shall modulate the exhaust fan to maintain the building pressure set point.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall verify that roof is ready to receive work and opening dimensions are as illustrated by the manufacturer.

B. Contractor shall verify that proper power supply is available.

3.2 INSTALLATION

A. Contractor shall install in accordance with manufacturer’s instructions.

B. Mount units on factory built roof mounting frame providing weathertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

C. Provide fully insulated curb.

3.3 MANUFACTURER’S FIELD SERVICES

A. The manufacturer shall furnish an alternative price for:

1. Extended compressor warranty for five years.
2. Extended heat exchanger warranty for five years.
3. Extended parts and labor by manufacturer to be provided to the owner for a period of one year.

B. The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as acceptable for field maintenance and service.

END OF SECTION 237400

SECTION 238126 - SPLIT SYSTEM DX AIR CONDITIONING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged Split System DX air handling units.

B. Refrigeration components.

1.2 RELATED SECTIONS

A. Section 23 05 13 – Motors and Starters

B. Section 23 40 00 – Air Cleaning

1.3 REFERENCES

A. ANSI/ASHRAE 15 – Safety Code for Mechanical Refrigeration.

B. ANSI/ASHRAE/IES 90.1A – 2001 - Energy Conservation in New Building Design Standard.

C. ARI 210/240 – Unitary Air-Conditioning Equipment and Air-Source Heat Pump Equipment, (less than 135,000 Btuh).

D. ARI 360 – Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard, (equipment greater than 135,000 Btuh).

E. ARI 340 – Commercial and Industrial Unitary Heat Pump Equipment, (heat pumps above 135,000 Btuh).

F. ANSI Z21.47/UL1995 – Unitary Air Conditioning Standard for safety requirements.

1.4 QUALITY ASSURANCE

A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

B. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

C. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

D. The units shall be rated in accordance with Air-conditioning, Heating and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.

E. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).

F. A dry air holding charge shall be provided in the indoor section.

1.5 SUBMITTALS

A. Submit unit performance data including capacity, nominal and operating performance.

B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.

D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. The wireless remote controller, for the wall mounted and floor standing indoor units, shall be shipped inside the carton and packaged with the indoor unit and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

D. The remote controller, for the ceiling suspended, ceiling recessed and ducted indoor units, either wireless or wired, shall be shipped separately.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.8 WARRANTY

A. The units shall have a manufacturer’s parts and defects warranty for a period five (5) years from date of installation. The compressor shall have an extended warranty of seven (7) years from date of installation.

B. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.

C. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer’s limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.

D. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required

PART 2 - PRODUCTS

2.1 OUTDOOR UNIT

A. General

1. The outdoor units are specifically designed to work with the indoor units. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

2. If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

3. Outdoor unit shall have a sound rating no higher than 55 dB(A). If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

4. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

5. The outdoor unit shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

6. The outdoor unit shall be capable 100% heating capacity to -5°F. The outdoor unit shall be capable of guaranteed operation in heating mode down to -13°F ambient and cooling mode up to 115°F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

7. Four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

B. Unit Cabinet

1. The casing shall be fabricated of galvanized steel, bonderized, finished with an

electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.

2. Cabinet color shall be Munsell 3Y 7.8/1.1.

3. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes.The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

C. Fan

1. The unit shall be furnished with a direct drive propeller type fan.

2. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings.

3. The fan motor shall be mounted for quiet operation.

4. The fan shall be provided with a raised guard to prevent contact with moving parts.

5. The outdoor unit shall have horizontal discharge airflow.

D. Refrigerant and Refrigerant Piping

1. R410A refrigerant shall be required for systems.

2. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the equipment manufacturer and installed in accordance with manufacturer recommendations.

4. All refrigerant piping must be insulated with ½” closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.

5. Refrigerant line sizing shall be in accordance with manufacturer specifications.

E. Coil

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.

2. The coil fins shall have a factory applied corrosion resistant Blue Fin finish. Uncoated aluminum coils/fins are not allowed.

3. The coil shall be protected with an integral metal guard.

4. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.

5. Outdoor unit shall be pre-charged with sufficient R-410a refrigerant for up to twenty five (25) feet of refrigerant piping.

6. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1” thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

7. All refrigerant connections between outdoor and indoor units shall be flare type.

F. Compressor:

1. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type manufactured by Mitsubishi Electric Corporation.

2. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.

3. The compressor will be equipped with internal thermal overload protection.

4. The outdoor unit must have the ability to operate over the full capacity range with a maximum height difference of 40 feet and refrigerant tubing length of 65 feet for capacities up to 12,000 BTU/h, and a maximum height difference of 50 feet and refrigerant tubing length of 100 feet for capacities 15,000 BTU/h and above between indoor and outdoor units.

5. There shall be no need for line size changes. Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.

6. The compressor shall be mounted so as to avoid the transmission of vibration.

G. Basepan Heater:

1. Each outdoor unit module shall be equipped with a basepan heater to protect the coil against ice build-up during prolonged winter operation. Basepan heater shall activate only if compressor is operating in heating mode at an outdoor ambient temperature of 36F or below.

H. Operating Range:

1. Operating Range shall be in accord with the Table below:

Operating Range		Indoor Intake Air Temp	Outdoor Intake Air Temp
Cooling	Maximum	95°F (35°C) DB, 71°F(21°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F(14°C) WB	14°F (-10°C) DB
Heating	Maximum	80°F (27°C) DB, 67°F(19°C) WB	75°F (24°C) DB, 65°F(18°C) WB
	Minimum	70°F (21°C) DB, 60°F(16°C) WB	6°F (-14°C) DB, 5°F(-15°C) WB
			-12°F (-24°C) DB, -13°F(-25°C) WB*

I. Electrical

1. The outdoor unit electrical power supply shall be 208/230 volts, 1-phase, 60 hertz.

2. The unit shall be capable of satisfactory operation within voltage limits of 187 volts to 253 volts.

3. The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit. A 12 to 24 volt DC data stream shall communicate between the units providing all necessary information for full function control

2.2 INDOOR UNIT

A. General

1. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet

1. The casing shall have a white finish – Munsell 1.0Y 9.2/0.2.

2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.

3. here shall be a separate back plate which secures the unit firmly to the wall.

C. Fan

1. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.

2. An integral, motorized, multi-position, horizontal air sweep vane shall provide for uniform air distribution, up and down. Vane shall have 5 selectable positions plus AUTO (Controls position based upon mode, microprocessor shall automatically determine the vane angle to provide the optimum room temperature distribution) and SWING (Continuously moves up and down). In OFF mode the horizontal vane shall return to the closed position.

3. A motorized adjustable vertical guide vane shall be provided with the ability to change the airflow from side to side (left to right). Vane shall be positioned by a stepper motor driven by the indoor unit control microprocessor. Vane shall have 5 selectable positions and SWING (Continuously moves left and right).

4. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of six (6) speed settings, Quiet, Low, Med, High, Super High and Auto (2 ton unit does not have Quiet setting).

D. Filter

1. Return air shall be filtered by means of two (2) easily removable, washable Nano Platinum Filters, an Electrostatic Anti-Allergy Enzyme Filter and a Deodorizing Filter with ceramic surface and nanotechnology for high-powered odor absorption.

E. Coil

1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.

2. The tubing shall have inner groves for high efficiency heat exchange.

3. All tube joints shall be brazed with silver alloy.

4. The coils shall be pressure tested at the factory.

5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.

6. A drain pan level switch (SS610E), designed to connect to the control board, shall be provided, if required, and installed in the condensate pan to prevent condensate from overflowing.

F. Electrical

1. The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.

2. The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground.

3. The indoor unit shall not have any supplemental electrical heat elements.

G. Controls

1. The unit shall include an IR receiver for wireless remote control flexibility

2. The unit shall ship with a backlit wireless handheld remote with the unit.

3. Indoor unit shall compensate for the higher temperature sensed by the return air sensor

compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

4. Control board shall include contacts for control of external heat source. External heat may be energized as second stage when the space temperature is 1.8°F from set poin

2.3 CONTROLS

A. The control system shall consist of a minimum of one microprocessor on each indoor unit and one in the outdoor unit, communicating via A-Control data over power transmission. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.

B. For A-Control, a three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a TAZ-MS303 3-Pole Disconnect shall be used – all three conductors must be interrupted.

C. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

D. A remote controller needs to be selected and ordered separately from the unit unless the indoor unit is a wall mounted (excludes PKA), floor mounted or one-way ceiling recessed unit.

2.4 REMOTE CONTROLLERS

A. Backlit Simple MA Remote Controller:

1. On wall mount (excludes PKA), floor mount and one-way ceiling recessed units the Backlit Simple MA Remote Controller shall require a MAC-334IF-E Interface for communication.

2. The Backlit Simple MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). When grouping M-Series units each unit requires a MAC-334IF-E Interface.

3. The Backlit Simple MA Remote Controller shall only be used in same group with another Backlit Simple MA Remote Controller, with up to two remote controllers per group.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install unit on vibration isolators. Reference Section 23 05 48.

END OF SECTION 238126

SECTION 238127 – VARIABLE REFRIGERANT FLOW (VRF) DX AIR CONDITIONING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged VR DX air handling units.

B. Refrigeration components.

1.2 RELATED SECTIONS

A. Section 23 05 13 – Motors and Starters

B. Section 23 40 00 – Air Cleaning

1.3 REFERENCES

A. ANSI/ASHRAE 15 – Safety Code for Mechanical Refrigeration.

B. ANSI/ASHRAE/IES 90.1A – 2001 - Energy Conservation in New Building Design Standard.

C. ARI 210/240 – Unitary Air-Conditioning Equipment and Air-Source Heat Pump Equipment, (less than 135,000 Btuh).

D. ARI 360 – Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard, (equipment greater than 135,000 Btuh).

E. ARI 340 – Commercial and Industrial Unitary Heat Pump Equipment, (heat pumps above 135,000 Btuh).

F. ANSI Z21.47/UL1995 – Unitary Air Conditioning Standard for safety requirements.

G. ISO 9001 Quality Management System

H. ISO 14001 Environmental Management System

I. Underwriters Laboratories (UL) 1995 Heating and Cooling Equipment Standard for Safety and bear the Electrical Testing Laboratories (ETL) label.

J. National Electrical Code (NEC) and all applicable state and local building codes.

K. Performance ratings certified by AHRI (Air-Conditioning, Heating, and Refrigeration Institute) and listed in the AHRI Standard 1230 certified product directory.

1.4 QUALITY ASSURANCE

A. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.

B. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

C. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

E. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.

F. System start-up supervision shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in system configuration and operation. The representative shall provide proof of manufacturer certification indicating successful completion within no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals.

1.5 SYSTEM PERFORMANCE DOCUMENTATION

A. The VRF manufacturer shall provide published outdoor unit performance data in table format which states the products heating and cooling capacity expressed in British thermal units per hour (BTUH) and power consumption expressed in kilowatts (kW). Performance data published at any and all operating conditions, including ambient outdoor air temperature, entering indoor unit air temperature, and proposed combination ratio (CR = sum of nominal cooling capacity of proposed indoor units/nominal cooling capacity of the outdoor unit) in these tables must guarantee continuous compressor operation. Tabular data that communicates performance at conditions where compressor may or may not be operating (commonly referred to as ‘Reference data’) is not acceptable documentation for VRF system performance. Any product whose system design and engineering manuals or guides where published data tables are expressed in units other than these specified will not be accepted.

B. Any product whose published documentation requires the design engineer to manually apply a correction factor derived from a published curve against nominal capacity to obtain corrected capacity shall not be accepted. Correction factor curves including but not limited to: a) Outdoor air temperature capacity and power input; b) Entering indoor unit air temperature capacity and power input; c) combination ratio capacity and power input; d) Heating mode pipe length capacity correction.

1.6 SUBMITTALS

A. Submit unit performance data including capacity, nominal and operating performance.

B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.

D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

E. VRF outdoor unit submittal data must include salt spray test results. Salt spray test shall be conducted per ASTM B-117 standard. The test shall be performed for a minimum of 1000 hours.

1.7 EQUIPMENT ALTERNATE

A. The alternate equipment supplier shall provide to the bidding mechanical contractor a complete equipment data package. This package shall include, but is not limited to, equipment capacities at the design condition, power requirements, indoor units CFM/static pressures, fan curves, installation requirements, and physical dimensions. Nominal performance data is not acceptable.

B. The mechanical contractor shall request and receive the equipment data package 15 days prior to bid date and submit this package with the alternate bid.

C. The mechanical contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated cost reduction of the alternate equipment. The contractor bids an alternate manufacturer with full knowledge that that manufactures product may not be acceptable or approved.

D. The alternate equipment supplier shall furnish a complete drawing package to the mechanical contractor 15 days prior to bid day for bidding and installation. The drawing format shall be .dxf or equivalent, on 30"x42" sheets. The HVAC and electrical series design documents will be made available in electronic format for use by the equipment supplier in preparing their drawings. The alternate equipment supplier shall prepare the following drawings:

XXX HVAC Floor Plan
XXX HVAC Refrigerant Piping Plan
XXX HVAC Refrigerant Piping/Controls Details
XXX HVAC Details
XXX HVAC Schedules

E. The alternate equipment supplier shall draft all piping circuits, components, overall building control schematic, detailed control wiring diagrams, system details and schedules for their system. The drawings shall convey all requirements to successfully install the alternate equipment suppliers system.

F. Provide (2) drawing package sets plotted on 20 lb. vellum. Provide (1) drawing package in electronic format (.dxf files) on CD.

G. The submitted documents shall be complete system designs and show no less information than the HVAC equipment/controls contract bid documents.

H. Provide the following scorecard(s) with the bid proposal for review by the bid selection committee for their respective system(s).

1.8 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data, troubleshooting guides, service manuals, and engineering manuals.

B. Provide the owner with the manufacturer's VRF system service diagnostics software

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.11 WARRANTY

A. Provide one year parts warranty and seven (7) year compressor to the owner from date of installation.

B. Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10) years to the original owner from date of installation. This warranty shall not include labor.

C. Manufacturer shall have a minimum of fifteen (15) years continuous experience providing VRF systems in the U.S. market.

D. All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.

E. The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Per the equipment schedule, the variable capacity, heat pump air conditioning system basis of design is Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system(s).

B. Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Daikin, Panasonic, and Hitachi. Contractor bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of

this document without further compensation.

2.2 OUTDOOR UNIT

A. General:

1. The outdoor unit modules shall be air-cooled, direct expansion (DX), multi-zone units used specifically with VRF components described in this section and Part 5 (Controls). The outdoor unit modules shall be equipped with a single compressor which is inverter-driven and multiple circuit boards—all of which must be manufactured by the branded VRF manufacturer. Each outdoor unit module shall be completely factory assembled, piped and wired and run tested at the factory.

2. Outdoor unit systems may be comprised of multiple modules with differing capacity if a brand other than basis of design is proposed. All units requiring a factory supplied twinning kits shall be piped together in the field, without the need for equalizing line(s). If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

3. Outdoor unit shall have a sound rating no higher than 65 dB(A) individually or 70 dB(A) twinned. Units shall have a sound rating no higher than 52 dB(A) individually or 54.5 dB(A) twinned while in night mode operation. Units shall have 5 levels sound adjustment via dip switch selectable fan speed settings. If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

4. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

5. The outdoor unit shall have the capability of installing the main refrigerant piping through the bottom of the unit.

6. The outdoor unit shall have an accumulator with refrigerant level sensors and controls. Units shall actively control liquid level in the accumulator via Linear Expansion Valves (LEV) from the heat exchanger.

7. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

8. VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

9. The outdoor unit shall be capable of guaranteed operation in heating mode down to -18°F ambient temperatures and cooling mode up to 126°F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not

acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

10. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained. Oil return sequences must be enabled only during extended periods of reduced refrigerant flow to ensure no disruption to correct refrigerant flow to individual zones during peak loads. Systems which might engage oil return sequence based on hours of operation risk oil return during inopportune periods are not allowed. Systems which rely on sensors (which may fail) to engage oil return sequence are not allowed.

11. Unit must defrost all circuits simultaneously in order to resume full heating more quickly during extreme low ambient temperatures (below 23F). Partial defrost, also known as hot gas defrost which allows reduced heating output during defrost, is permissible only when ambient temperature is above 23F.

12. While in hot gas defrost the system shall slow the indoor unit fan speed down to maintain a high discharge air temperature, systems that keep fan running in same state shall not be allowed as they provide an uncomfortable draft to the indoor zone due to lower discharge air temperatures.

13. The outdoor unit shall be capable of operating in cooling mode down to -10°F with manufacturer supplied low ambient kit.

    a. Low ambient kit shall be provided with predesigned control box rated for outdoor installation and capable of controlling kit operation automatically in all outdoor unit operation modes.

    b. Low ambient kit shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

    c. Low ambient kit shall be factory tested in low ambient temperature chamber to ensure operation. Factory performance testing data shall be available when requested.

14. VRF four-legged outdoor unit mounting systems shall be provided by manufacturer. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

B. Unit Cabinet

1. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

2. The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

3. Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

C. Fan

1. Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only. Fans shall be factory set for operation at 0 in. WG external static pressure, but capable of normal operation with a maximum of 0.32 in. WG external static pressure via dipswitch.

2. All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.

3. All fans shall be provided with a raised guard to prevent contact with moving parts.

D. Refrigerant and Refrigerant Piping

1. R410A refrigerant shall be required for systems.

2. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.

4. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.

5. Refrigerant line sizing shall be in accordance with manufacturer specifications.

E. Coil:

1. Outdoor Coil shall be constructed to provide equal airflow to all coil face surface are by means of a 4-sided coil.

2. Outdoor Coil shall be elevated at least 12" from the base on the unit to protect coil from freezing and snow build up in cold climates. Manufacturer's in which their coil extends to within a few inches from the bottom of their cabinet frame shall provide an additional 12" of height to their stand or support structure to provide equal protection from elements as Mitsubishi Electric basis of design. Any additional support costs, equipment fencing, and tie downs required to meet this additional height shall be responsibility of Mechanical Contractor to provide.

3. The outdoor heat exchanger shall be of zinc coated aluminum construction with turbulating flat tube construction. The coil fins shall have a factory applied corrosion resistant finish. Uncoated aluminum coils/fins are not allowed.

4. The coil shall be protected with an integral metal guard.

5. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

6. Unit shall have prewired plugs for optional panel heaters in order to prevent any residual ice buildup from defrost. Panel heaters are recommended for operating environments where the ambient temperature is expected to stay below -1F for 72 hours.

7. Condenser coil shall have active hot gas circuit direct from compressor discharge on lowest coil face area to shed defrost condensate away from coil and protect from Ice formation after returning to standard heat pump operation. While in Heat Pump operation this lower section of the Outdoor Evaporator coil shall continually run hot gas from the compressor discharge to protect the coil from ice buildup and coil rupture. Manufacturers who do not have an active hot gas circuit in the lower section of the Outdoor coil to protect coil from freezing shall not be allowed to bid on project in markets where the outdoor unit will see temperatures below freezing.

F. Compressor:

1. Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.

2. Each compressor shall be equipped with a multi-port discharge mechanism to eliminate over compression at part load. Manufacturer's that rely on a single compressor discharge port and provide no means of eliminating over compression and energy waste at part load shall not be allowed.

3. Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting "belly-band" type crankcase heaters are not allowed. Manufacturers that utilize belly-band crankcase heaters will be considered as alternate only.

4. Compressor shall have an inverter to modulate capacity. The capacity for each compressor shall be variable with a minimum turndown not greater than 15%.

5. The compressor shall be equipped with an internal thermal overload.

6. Field-installed oil equalization lines between modules are not allowed. Prior to bidding, manufacturers requiring equalization must submit oil line sizing calculations specific to each system and module placement for this project.

7. Manufacturers that utilize a compressor sump oil sensor to equalize compressor oil volume within a single module shall not be allowed unless they actively shut down the system to protect from compressor failure.

G. Controls

1. The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor e control circuit. Required field-installed control voltage transformers and/or signal

boosters shall be provided by the manufacturer.

2. The outdoor unit shall have the capability of 4 levels of demand control for each refrigerant system based on external input.

H. Electrical

1. The outdoor unit electrical power shall be 208/230 volts, 3-phase, 60 hertz or 460 volts, 3-phase, 60 hertz per equipment schedule.

2. The outdoor unit shall be controlled by integral microprocessors.

3. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.3 INDOOR UNITS

A. Wall Mounted Unites

1. General

a. The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

2. Unit Cabinet

a. All casings, regardless of model size, shall have the same white finish

b. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.

c. There shall be a separate back plate which secures the unit firmly to the wall.

3. Fan

a. The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.

b. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).

c. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

4. Filter

a. Return air shall be filtered by means of an easily removable, washable filter.

5. Coil

a. Basis of design indoor units include factory-installed LEV/EEV. Alternative brands which require field-installed, accessory LEV or EEV kits are permissible only with written Engineer and Architect approval for the location of kits being submitted two weeks prior to bid date. EEV kits mounted in cavities inside fire-rated interior walls shall be mounted inside three hour fire rated enclosures with access panels supplied by the manufacturer. Enclosure type and placement require prior approval.

b. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

c. The coils shall be pressure tested at the factory.

6. Electrical

a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

7. Controls:

a. The unit shall include an IR receiver for wireless remote control flexibility

b. unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

c. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

d. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

e. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

B. Medium Static Ceiling-Concealed Ducted Indoor Unit

1. General

a. The ceiling-concealed ducted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit

shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

2. Unit Cabinet

   a. The unit shall be ceiling-concealed, ducted—with a 2-position, field adjustable return and a fixed horizontal discharge supply.

   b. The cabinet panel shall have provisions for a field installed filtered outside air intake.

3. Fan

   a. Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG.

   b. The indoor unit fan shall be an assembly with statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.

   c. The indoor fan shall consist of three (3) speeds, High, Mid, and Low plus the Auto-Fan function

4. Filter

   a. Return air shall be filtered by means of a standard factory installed return air filter. Filter shall have a minimum rating of MERV 8.

5. Coil

   a. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

   b. The coils shall be pressure tested at the factory.

   c. Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed.

   d. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 27 inches above the condensate pan.

6. Electrical

   a. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

   b. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

7. Controls:

a. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

b. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

c. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

d. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

2.4 OVERVIEW

A. The control system shall consist of a low voltage communication network and a web-based interface. The controls system shall gather data and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

B. Furnish energy conservation features such as optimal start, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.

C. System shall be capable of email generation for remote alarm annunciation.

2.5 ELECTRICAL CHARACTERISTICS

A. General

1. Controller power and communications shall be via a common non-polar communications bus and shall operate at 30VDC.

B. Wiring

1. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

2. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.

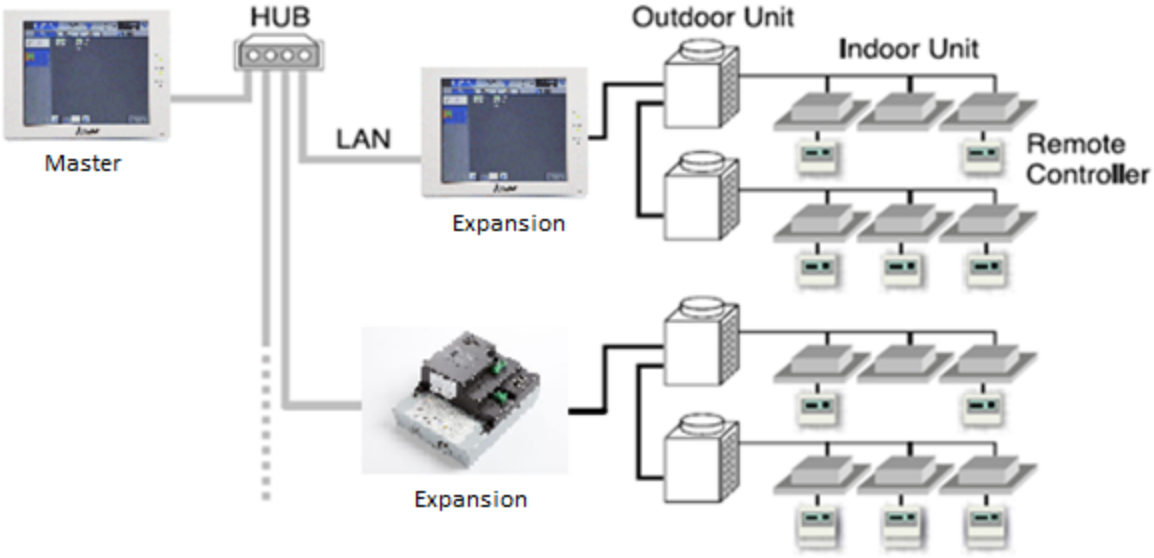
C. Wiring type

1. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.

2. Network wiring shall be CAT-5 with RJ-45 connection.

2.6 CITY MULTI CONTROLS NETWORK

A. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.



CMCN System Configuration

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install unit on vibration isolators. Reference Section 23 05 48.

C. Locate indoor and outdoor units as indicated on drawings. Provide service clearance per manufacturer’s installation manual. Adjust and level outdoor units on support structure.

D. Components / Piping:

1. Installing contractor shall provide and install all accessories and piping for a fully operational system. Refer to manufacturer’s installation manual for full instructions.

2. Traps, filter driers, and sight glasses are NOT to be installed on the refrigerant piping or condensate lines.

3. Standard ACR fittings rated for use with R410A are to be used for all connections. Proprietary manufacturer-specific appurtenances are not allowed.

E. Insulation:

1. Refrigerant lines, as well as any valves, shall be insulated end to end. See 23 07 00 specifications.

END OF SECTION 238126

SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 SAFETY STANDARDS

A. Provide electric heating coil in compliance with the National Electric Code and listed by UL for zero clearance and so labeled.

1.2 CAPACITY RATINGS

A. Hydronic Coils: Certified per ARI 410.

1.3 SUBMITTALS

A. Submit manufacturer's product data including:

1. Performance data.
2. Accessories description
3. Operating weight.
4. Drawings showing:
   a. Dimensions.
   b. Sizes and locations of connections.
5. Support requirement.

1.4 FACE VELOCITY

Unless otherwise noted face velocities shall not exceed the following:

A. Cooling Coils: 500 fpm.

B. Heating Coils: 750 fpm. (except electric coils)

PART 2 - PRODUCTS

2.1 ELECTRIC HEATING COILS

A. Manufacturers:

1. Design Basis: Indeeco.
2. Other Acceptable Manufacturers:
   a. Brasch.
   b. Trane.
   c. Warren

B. Description:

1. Type: Finned tubular.
2. Mounting: Casing suitable for mounting in duct as required. As shown on the drawings.

3. Heaters shall be U.L. listed for zero clearance and meet all the applicable requirements of the Latest Edition of National Electrical Code or other local codes.
4. Heaters shall be made with galvanized or aluminum steel frame.
5. The terminal box shall be provided with solid hinged cover in order to minimize dust infiltration.
6. All resistance coil terminals and nuts shall be made of stainless steel, and terminal insulators and bracket bushings shall be made of high grade ceramic and securely positioned. Resistance wire shall be iron free, 80% nickel and 20% chromium. Bracket supports for the resistance wire shall be reinforced with stiffening ribs and gussets, and spaced no more than four inches apart. Heaters shall be tested dielectrically for 1000V plus twice and rated voltage of 2000V, whichever is higher. Heaters rated 150 KW and over shall be furnished with heavy duty coils, derated to 25 watts/in^2 of wire surface, to insure long life.
7. Heaters shall be suitable for mounting in a horizontal or vertical duct, as shown on the Drawings, and air flow may be through the heater in either direction.
8. Electric heaters shall be of the slip-in type, unless otherwise noted. Flanged heaters shall be constructed by having a slip-in heater inserted into a flanged frame and flanges shall be independent of the terminal box.
9. Heaters shall be furnished for single or three phase power as scheduled. Three phase heaters shall be furnished with balanced three phase steps. The control voltage shall be 120 volts, internally wired through control transformer fused on the secondary.
10. Overcurrent protection shall consist of built-in and pre-wired dual element fuses with clip reinforcing springs.
    a. With one overcurrent device for each 40 ampere circuit.
    b. And with one overcurrent device for entire heater for those heaters rated 40 amperes or less only.
11. A disc type automatic reset thermal cutout in control lines, shall be furnished for primary protection. Heat limiters in all power lines shall be provided for secondary protection. In addition a disc type manual reset thermal cutout with bulb extending the length of the heater shall be furnished. Manual reset thermal cutout to be in series with automatic reset thermal cutout. All three devices shall be serviceable through the terminal box, without having to remove heater from duct. In lieu of heat limiters, disc type manual reset thermal cut-outs will be acceptable.
12. Air ducts rated as Class 1 in accordance with UL 181, air duct coverings and linings shall be interrupted at the immediate area of operation of such heat sources in order to meet the clearances specified by the manufacturer.
13. The following accessories shall be furnished and built in for each heater, unless otherwise noted:
    a. Insulated terminal box.
    b. Magnetic contactors (when load exceeds control device ratings).
    c. Transformer with primary fuse protection to supply control voltage, when power supply exceeds 120 volts.
    d. Air flow switch - pressure type.
    e. Control contact for each step.
    f. Non-fused disconnect with interlocking door handle.
14. Controls:
    a. Provide factory mounted and wired control panel.
    b. Control Option: SCR
    c. Thermostat: Room
    d. Standard Features:
        1) Thermal Cutoffs.

2) Airflow Switch.
3) Magnetic Contactors.
4) Control Transformer.
5) Fuses.

2.2 REFRIGERATION COILS

A. Tubes - Round, seamless copper tubes, arranged in parallel pattern with respect to airflow.

B. Fins - Plate-Tube, Sigma-Flo II configurated, aluminmum fins producing identical capacities. Fins continuous across entire coil width and die-formed in multiple stages for accurate tube fit, fin bonding and spacing. Fins mechanically bonded to tubes for lasting reliability.

C. Casing - Continuous coated galvanized steel, 16 gauge formed end supports and top and bottom channels. 3/8" holes on 3" centers in channels for mounting or fastening coils together. One 16 gauge continuous coated, galvanized steel center tube support on ordering lengths over 42". Two or more supports on lengths over 96".

D. Test and Working Pressure - Proof tested at 450 psig and leak tested at 300 psig air pressure under water, cleaned, dehydrated and sealed with dry nitrogen charge. Suitable for working pressures up to 250 psig.

E. U-Bends - Round, seamless copper tubes, 5/8" O.D., machine die-formed on each end to provide accurate fit for silver brazed joints.

F. Distributor - Equalizing type refrigerant distributors of low pressure drop design, arranged for down feed. Male sweet connections. Maximum of twelve circuits per single distributor. Split evaporator.

G. Air Bypass and Water Carryover Arrestor - Foam sealing strip located between casing channels and fins along top and bottom.

H. Designed to conform to ANSI-B9.1 Safety Code for mechanical refrigeration.

I. Coils to be vertical split.

J. Accessories:

1. Distributor with hot gas bypass connection.
   a. Thermal expansion valve.
   b. Size per manufacturers requirements.
   c. Insulate sensing bulb.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All coils shall incorporate an air-water counter flow piping arrangement.

B. Install coils level and plumb.

C. Provide necessary auxiliary support.

D. Adjust air flow switch for safe operation.

E. When electric heating coils are used and the airflow sensor is a pressure sensor type, provide adjustable volume damper(s) as necessary downstream of VAV box before first split in ductwork in order to create sufficient total pressure at the air flow pressure sensor to properly verify air flow.

F. Check and adjust all controls.

G. Pipe condensate drain from cooling coils as shown on the drawings or to nearest floor drain or mop sink.

H. Contractor shall examine location where this equipment is to be installed and determine space conditions and notify architect in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

I. Install coils where shown, in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that coils comply with requirements and serve intended purposes.

J. Coordinate with other work as necessary to interface installation of coils with other components of systems.

END OF SECTION 238216

SECTION 238239 - HEATING TERMINAL UNITS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data:

1. Performance data.
2. Drawings.
   a. Dimensions
   b. Support requirements
   c. Size and location of connections
3. Enclosure gauges.
4. Accessories.
5. Parts lists.
6. Additional Submittal Requirements for Fan Coil Units, Cabinet Heaters and Unit Heaters:
   a. Wiring diagrams.
   b. Installation, operating and maintenance instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products as indicated by published product information, and as required for a complete installation.

2.2 CONVECTORS

A. Manufacturers:

1. Design Basis: Sterling
2. Other Acceptable Manufacturers:
   a. Vulcan
   b. Trane

B. Style:
1. Recessed

   a. Front Outlet
   b. Stamped Louvers

C. Heating Element:

1. Header: Bronze
2. Tubes: Copper.
3. Fins: Aluminum.
4. Construction: Tubes expanded into plate fins.

D. Cabinet:

1. Material: Steel.
2. Gauge:
   a. Front: 14 gauge.
   b. Back and Sides: 16 gauge.
3. Finish Inside and Out:
   a. Treatment: Phosphatize.
   b. Primer: Grey enamel primer, baked on.
   c. Top Coat: Baked enamel.
   d. Color: Selected by Architect from manufacturer's standard colors.
4. Front Panel: Removable.
5. Air Vent: Assembly consisting of:
   a. Manual vent.
   b. Tubing extension.
   c. Air chamber.
6. Dampers:
   a. Key operated, tamper proof.
   b. Knob or chain type.
7. Panel Fasteners:
   a. Tamper proof:
      1) Allen head machine screws.
      2) Spanner wrench operated cam fastener.
8. Insulation:
   a. Factory installed insulation on the back, sides, and top.
9. Gaskets:
   a. Location: Between front panel and enclosure on recessed units.
   b. Material: Manufacturer's standard.

2.3 ELECTRIC UNIT HEATERS

A. Manufacturers:

1. Design Basis: Trane.
2. Other Acceptable Manufacturers:
   a. Carrier
   b. McQuay
   c. Dunham-Bush
   d. Modine

B. Construction:

1. Casing:
   a. Material: Steel.
   b. Finish: Baked-on enamel.
   c. Heating Element Supports: Adjustable.
   d. Gaskets: Between front panel and enclosure.
2. Grilles: Louver: Adjustable.
3. Heating Element: Finned steel sheaths providing extended surface.

4. Provide manufacturer's written certification that unit is suitable for use at altitude of the project.

C. Control box housing, all heater wiring controls and contractors shall be located at bottom of heater and equipped with swing down hinged cover. Wiring diagram shall be attached to the inside of the control box cover.

D. 3-Pole units shall have a built in heavy duty 3-pole contactor.

E. Heating element shall be of non-flowing design consisting of special resistance wire enclosed in a steel sheath to which steelplate fins are brazed. Heating element shall cover the entire air discharge area for uniform heating.

F. Thermal safety cutout shall be built into system to automatically shut off heater in event of overheating.

G. Electric space thermostat shall be furnished by the unit manufacturer for installation by automatic controls contractor.

H. Disconnect switch shall be provided under Electrical Documents.

PART 3 – EXECUTION

3.1 GENERAL

A. Locate units so clearance is provided for:

1. Service and maintenance.
2. Enclosure removal.

B. Level or pitch elements as required:

1. Install shims if necessary.

C. Touch-up finish after final adjustment.

D. Replace damaged enclosures.

E. Straighten bent fins.

F. Replace damaged elements.

END OF SECTION 238239

SECTION 239000 - PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Test and balance reports
5. Record drawings
6. Permit requirements
7. Valve tag list

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.
4. Test and Balance report.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

E. If submitted digitally, each item above shall be separated in a different file or digital bookmark, per trade.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.

2. Preliminary schedule showing major milestones for completion of the mechanical systems.

B. Within 30 days of the first major milestone submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary – Mechanical

☐ All required submittals have been submitted and either been approved or modified in accordance with the Engineer’s “make corrections noted” comments.

☐ Clean filters installed in all units. (Install just prior to building turnover)

☐ All equipment has been started up and is functioning within manufacturers’ recommendations without any undue noise or vibration. (Submit a list of equipment with startup dates. Provide list at a point 65% into construction schedule).

☐ All vibration isolation has been installed and is operating properly.

☐ Duct access doors have been installed at fire and fire/smoke dampers and are properly fire-stopped and fire and fire/smoke dampers have been visually inspected to confirm that they are open.

☐ Access doors have been installed as required for concealed equipment, water hammer arrestors, valves, controls, actuators, etc.

☐ All equipment has been installed with the manufacturers recommended service clearances and is fully accessible for required maintenance.

☐ All equipment and piping is labeled per specifications.

☐ All piping cleaned, flushed and tested per specifications. Submit all required test and balance reports for record.

☐ All action items are complete as listed in the action items reports. Submit a list of action items with sign off by Architect or Engineer for record. Punch list to be completed prior to turn over of building.

☐ Temperature control system complete and tested per specifications.

☐ Test and balance complete and report submitted and accepted by Engineer.

☐ Operation and maintenance manuals submitted with table of contents and required documentation for extended warranties.

☐ Factory Testing documented and submitted for record.

☐ Record drawings submitted per specifications.

☐ Temperature Control record documents provided per specifications.

☐ Temperature Control Point to point checkout documents submitted.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 COORDINATION WITH OTHERS

A. The Division 21 through 23 contractor shall coordinate his requirements with the General Contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 21 through 23 systems.

3.3 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION 239000

ELECTRICAL TABLE OF CONTENTS – SPECIFICATIONS - DIVISIONS 26, 27 & 28

END OF ELECTRICAL TABLE OF CONTENTS

SECTION 23 05 01 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Divisions 21, 22, 23, 24, 25, 26, 27 and 28 contractor(s) shall comply with the provisions of this section. The Divisions 21, 22, 23 and 25 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26, 27 and 28 contractor(s).

B. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21, 22, 23 and 25 System Contractor performing the work, which requires the electrical power.

1. Each Divisions 21, 22, 23 and 25 contractor shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26, 27 and 28 specifications, NEC and local codes.

1.2 WORK INCLUDED

A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and Division 23 and 25 (control) before submitting any equipment for review or commencing installation.

1.3 DEFINITIONS

A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.

B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.

C. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.

D. Manual Operation: Operation by hand without the use of any other power.

E. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.

F. TC: Temperature Controls = Division 22, 23 or 25 Contractor who furnishes control.

G. EC: Electrical Contractor = Divisions 26, 27or 28 Contractor.

H. FA: Fire Alarm Contractor = Division 25 or 28 Contractor who furnishes Fire Alarm System.

I. SC: Sprinkler Contractor

J. EP: Electric to Pneumatic Converter.

K. PE: Pneumatic to Electric Converter.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21, 22, 23 and 25 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	Furnished By	Set In Place By	Power Wiring By	Control Wiring By
Disconnect Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC, EC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC, EC or TC	MC or TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	--	TC/FA
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	FA	--	FA
Fire/Smoke and Smoke Dampers (Note 6)	MC	MC	EC	FA/TC (Note 7)
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC (Note 7)

Notes:

1. If furnished as part of factory wired equipment furnished and set in place by MC, wiring and connections by EC. Electrical Contractor shall provide disconnects for all electrical equipment unless otherwise indicated.
2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set in place by MC and connected by EC. If they do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor. Such devices shall be provided at low voltage unless technically impossible
3. Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided by the electrical contractor.
4. Electrical contractor is responsible for wiring from disconnect to starter and from starter to motor, unless factory wired.
5. Temperature control contractor shall provide conduit and wire from auxilary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.
6. FA wires to components necessary for the operation and monitoring of the Smoke Management System. TC wires to components utilized in the control and monitoring of the Automated Building Control System. This often requires dual wiring where

components are controlled by both. In such case wiring and relays shall be provided to ensure FA takes precedence in control over TC.

1.5 GENERAL REQUIREMENTS

A. Connections:

1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

B. Remote Switches and Pushbutton Stations:

1. Provide remote switches and/or pushbutton stations required for manually operated equipment (if no automatic controls have been provided) complete with pilot lights of an approved type lighted by current from load side of starter.

C. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

D. Identification:

1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch, or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

E. Control Voltage:

1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

F. DDC Control Interface:

1. Fully coordinate the requirements of each division with regard to supplying a complete DDC Control System prior to submitting bid.
2. All power to controllers and controlled equipment shall be furnished via dedicated line voltage circuits.
3. Dedicated control circuits from electrical panelboards to DDC control panels and from electrical panelboards to dedicated DDC J-boxes (for distributed control components such as VAV boxes), and control transformer line voltage connections shall be provided by HVAC Contractor where required.
   a. Exceptions: Where power wiring has been shown on Electrical Drawings.
4. Low voltage wiring from J-boxes to distributed control components, all low voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23 or 25.
5. Any additional power requirements shall be the responsibility of the Division 23 or Contractor requiring same and provided at no additional cost to the owner.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Supply, return and exhaust ductwork.
2. Electrical conduit greater than 3” diameter.
3. Fire sprinkler mains and leaders.
4. Electrical conduit branch feeders.
5. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, extending from the face of the ceiling to an elevation 2” above the height of the light fixtures.

C. Examine the contract documents of all trades (e.g. all Divisions 21, 22, 23, 25, 26 and 28 the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise unaccessible locations.

1. For equipment located in “accessible locations” such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. “Normal maintenance” includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.
2. All system components requiring access shall be grouped together to reduce the quantity of access doors required.

G. See “Basic Mechanical Materials and Methods” for additional access door requirements if section has been included in this specification.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 260501

SECTION 260503 – TESTING

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Acceptance and startup testing requirements for electrical power distribution equipment and systems. Contractor shall retain and pay for the services of a recognized independent testing firm for purpose of performing inspections and tests as herein specified.

1. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
2. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
3. The tests and inspections shall determine suitability for startup and energization.
4. The following equipment shall be tested and or calibrated:

Low Voltage Power Wires and Cables - Section 26 05 19
Grounding - Section 26 05 26
Low Voltage Transformers - Section 26 22 00
Panelboards – Section 26 24 13

1.2 SUBMITTALS

A. Provide submittal per Contract General Conditions, Division 1, and Section 26 05 02.

B. Qualification of testing firm.

C. Submit PDF copies of certified test reports to Engineer for approval.

D. PDF copies of blank forms for checklists, test reports, and other related forms for Engineer's review and approval.

1.3 GENERAL REQUIREMENTS

A. The Contractor shall perform routine insulation resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to any acceptance testing.

B. The Contractor shall test all lighting, low voltage relays and circuits to ensure proper operating conditions prior to acceptance testing.

C. The Contractor shall perform visual and mechanical inspections, verifying that the equipment nameplate information meets the intent of the drawings and specifications.

D. The Contractor shall be responsible for all final settings and adjustments on protective devices and tap changes, submitting settings to the Architect/Engineer for review.

E. Provide a complete short-circuit study, equipment interrupting/withstand evaluation, and a protective device coordination study for the electrical distribution system described herein. This study shall be submitted with electrical equipment submission and electrical room layouts.

F. The Contractor shall engage the services of a recognized corporate and financially independent testing firm for the purpose of performing inspections and tests as herein specified.

G. The firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

H. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

I. The tests and inspections shall determine suitability for energization. Equipment shall not be energized until accepted by the testing firm.

J. Prior to performing tests, the contractor shall notify the Architect a minimum of one week in advance, so that the Architect may schedule a representative to be present while tests are being conducted.

K. Any defects shall be corrected at once, and the tests reconducted.

L. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

M. The tests shall be performed by competent personnel and shall demonstrate the following:

1. That all lighting, power and control circuits are continuous and free from short circuits.
2. That all circuits are free from unspecified grounds.
3. That all connections within panelboards are tight and do not produce excess heating.
4. That the resistance to ground of all non-grounded circuits is not less than one megohm.
5. That all circuits are properly connected in accordance with the applicable wiring diagrams.
6. That all circuits are operable by which a demonstration shall include functioning of each control not less than three times and continuous operation of each lighting and power circuit for not less than 1/2 hour.
7. That all alarm and signal systems and all emergency and exit lights are properly functioning.

N. When wiring systems are "megger" tested, the insulation resistance between conductors and between conductors and grounds, based on maximum load, shall not be less than that required by Electrical Code and local authorities having jurisdiction.

O. A digital copy of record of all test data shall be supplied to the Architect (three copies). The tests shall cover but not be limited to the following:

1. Secondary distribution system.
2. Emergency distribution system.
3. Fire alarm, sprinkler and smoke detection systems.

4. All communications, signaling and alarm systems.
5. Power installations and motor controls.
6. Light installations and circuit switching.
7. Any part of the work called for in the Specification, or Drawings and as designated by the Architect or Engineers.

P. If in the opinion of the Architect, the results of such tests show that the work has not complied with the requirements of the Specifications or Drawings, the Contractor shall make all additions or changes necessary to put the system in proper working condition and shall pay for all the expenses and for all subsequent tests which are necessary to determine whether the work is satisfactory. Any additional work or subsequent tests shall be carried out at the convenience of the Owner, prior to final payment.

1.4 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be a recognized corporate and financially independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the InterNational Electrical Testing Association (NETA).

D. The lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing and engineering services. All studies, tests, and reports shall be sealed by a registered electrical professional engineer with a current New York State stamp.

F. The testing firm shall submit proof of the above qualifications with bid documents, when requested.

G. The terms used herewith, such as test agency, test contractor, testing laboratory, or contractor test company, shall be construed to mean the testing firm.

1.5 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturer’s Association - NEMA
2. American Society for Testing and Materials - ASTM
3. Institute of Electrical and Electronic Engineers - IEEE
4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-1991
5. American National Standards Institute - ANSI C2: National Electrical Safety Code

6. State and City of Valhalla Codes and Ordinances
7. Insulated Cable Engineers Association - ICEA
8. Association of Edison Illuminating Companies - AEIC
9. Occupational Safety and Health Administration - OSHA
10. National Fire Protection Association - NFPA
    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 78: Lightning Protection Standard
    e. ANSI/NFPA 101: Life Safety Code

B. All inspections and tests shall utilize the following references:

1. Project design specifications.
2. Project design drawings.
3. Short-circuit and coordination study.
4. Manufacturer's instruction manuals applicable to each particular apparatus.
5. Project list of equipment to be inspected and tested as stated above.

PART 2 - SHORT-CIRCUIT AND COORDINATION STUDY

2.1 SHORT-CIRCUIT STUDY

The electrical equipment manufacturer shall perform a short-circuit analysis of the specified electrical power distribution system. This analysis shall include:

A. Calculation of the maximum RMS symmetrical three-phase short-circuit current available at significant locations in the electrical system. The results shall represent the highest short-circuit currents to which the equipment might be subjected under the reported system conditions. The short-circuit currents shall be calculated with the aid of a digital computer. Appropriate motor short-circuit contribution shall be included in the calculation.

B. The study shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.

C. The study shall be calculated from the utility meter to the unit substation to the lowest overcurrent device or equipment on the electrical distribution system. The utility conductors shall not be used for calculations.

D. An evaluation of the adequacy of the short-circuit ratings of the electrical equipment supplied by that manufacturer.

E. Provide five copies of the short-circuit analysis for the engineer's approval within 60 days of contract award.

F. A computer printout of input data, a computer printout of calculated results and an explanation of how to interpret the printouts.

G. A one-line diagram identifying all bus locations and the maximum available short-circuit current at each bus.

H. A bus-to-bus listing of the maximum available short-circuit current expressed in RMS symmetrical amperes and the X/R ratio of the fault current.

I. A table of equipment short-circuit ratings versus calculated short-circuit current values.

J. The short circuit and coordination study shall be completed and forwarded for review within 120 days after award of the contract.

K. At the time of the final inspection and tests, all connections at the panels and all splices, etc., must have been completed. All fuses must be in place and the circuits continuous from service switches to all receptacles, outlets, motors, etc.

L. An analysis of the results in which any inadequacies shall be called to the attention of the Engineer and recommendations made for improvements. These recommendations shall be incorporated by the electrical equipment manufacturer to the electrical equipment at no cost to the Owner. Where approved by the Engineer.

2.2 PROTECTIVE DEVICE COORDINATION STUDY

The electrical equipment manufacturer shall perform a protective device time-current coordination analysis of the specified electrical power distribution system. This analysis shall include:

A. A determination of settings or ratings for the over-current protective devices supplied. Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance. The time-current coordination analysis shall be performed with the aid of a digital computer.

B. An evaluation to the degree of system protection and service continuity possible with overcurrent devices supplied.

C. Provide five copies of the protective device time-current coordination analysis for the Engineer’s approval.

D. Log-Log plots of time-current characteristic curves.

E. A tabulation of the suggested settings of the adjustable overcurrent protective devices supplied.

F. The key or limiting overcurrent device characteristics, load characteristics, and protection requirements affecting the setting or ratings of the overcurrent protective devices supplied.

G. The degree of service continuity and system protection achieved with the overcurrent protective devices supplied.

H. An analysis of the results in which any inadequacies shall be called to the attention of the Engineer and recommendations made for improvements. These recommendations shall be incorporated by the electrical equipment manufacturer to the electrical equipment at no cost to the Owner, where approved by the Engineer.

2.3 ARC FLASH HAZARD ANALYSIS

A. Provide with the coordination and short circuit studies an Arc Flash study and device by device listing of PPE requirements and ratings as required by the NEC and NFPA 70E. All equipment shall have appropriate labeling installed in the field by the electrical contractor as determined by the study.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchgear, switchboards, panelboards, busway, etc.) where work could be performed on energized parts.

PART 3 - INSPECTION AND TEST PROCEDURES

3.1 PROCEDURE

A. Testing firm to provide and comply with the following:

1. Acceptance test procedures for each individual equipment listed in Part 1 of this section for Engineer review and approval prior to any test and after thorough evaluation of the system. Testing shall conform to the latest version of InterNational Electrical Testing Association (NETA) specifications and standards for electrical power distribution equipment and systems and manufacturer's instructions.
2. Refer to each individual specification section for testing requirements and comply.
3. Inspect installed equipment, record results and report any discrepancy and deficiency with contract documents and governing codes prior to testing. All results shall be submitted to the Engineer for approval.

3.2 SYSTEM FUNCTION TESTS

A. General:

1. Perform system function tests upon completion of equipment component tests as define in this specification. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.
2. Implementation:
   a. Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements.
   b. Test all interlock devices, and trip settings on breakers.
   c. Record the operation of alarms and indicating devices.

3.3 DEFICIENCIES

A. All deficiencies reported by testing firm to be corrected by Contractor and Acceptance Test to be re-done accordingly.

END OF SECTION 260503

SECTION 260505 - MANUFACTURERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The following lists of manufacturers are for the specifications as identified.

B. All submittals and documentation shall be in accordance with the project General Requirements, Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturing firms regularly engaged in manufacture of this material with characteristics and capacities required, whose products have been in satisfactory use in similar service for not less than 10 years.

B. Provide product produced by the manufacturers, which are listed in Section "Approved Manufacturer's List".

C. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are listed herein. All manufacturers not listed shall be pre-approved prior to bid in order to be considered. Refer to Division 1 for pre-approval format.

TITLE	SPECIFICATION SECTION	MANUFACTURER
Electrical Identification	26 05 53	Ideal Industries, Inc. National Band and Tag Co. Panduit Corp. Seton Name Plate Co. W.H. Brady, Co.
Raceways		
Conduit & Tubing	26 05 33	Alflex Div.; Southwire Co. Allied Div.; Atkore Carlon, Inc. Liquatite Div.; Electri-Flex Wheatland Tube Co.
Conduit Bodies	26 05 33	Appleton Div.; Emerson Electric Crouse-Hinds Div.; Eaton Killark Div.; Hubbell Inc. OZ/Gedney Div.; Emerson Electric Steel City Div.; Thomas & Betts

TITLE	SPECIFICATION SECTION	MANUFACTURER
Wireway & Enclosures	26 05 33	B-Line Div.; Eaton Hammond Mfg. Hoffman Div.; Pentair Square D Div.; Schneider Electric
Surface Raceways	26 05 33	Hubbell Inc. Isoduct Div; Legrand Square D Div.; Schneider Electric Wiremold Div.; Legrand
Wire and Cables	26 05 19	General Cable Okonite Co. Prysmian Southwire Co.
Electrical Boxes & Fittings		
Raintight outlet boxes	26 05 34	Appleton Div.; Emerson Electric OZ/Gedney Div.; Emerson Electric RACO Div.; Hubbell, Inc. Steel City Div.; Thomas & Betts
Bushings, knockout closures and locknuts	26 05 34	Appleton Div.; Emerson Electric Midwest Electric OZ/Gedney Div.; Emerson Electric RACO Div.; Hubbell, Inc. Thomas & Betts
Wiring Devices		
Receptacles & Switches	26 27 26	Hubbell, Inc. Arrow Hart Div.; Eaton Leviton Lightolier Lutron
Supporting Devices		
Slotted metal Angle & U-channel Systems	26 05 29	American Electric B-Line Div.; Eaton Unistrut Div.; Atkore
Conduit Sealing Bushings	26 05 29	OZ/Gedney Div.; Emerson Electric RACO Div.; Hubbell, Inc. Thomas & Betts
Panelboards	26 24 13	Cutler-Hammer Div.; Eaton
Transformers	26 22 00	Cutler-Hammer Div.; Eaton
Grounding	26 05 26	Burndy Electrical Cadweld Div.; Erico Ideal Industries Okonite
Lighting Fixtures	26 51 00	Refer to Drawings

TITLE	SPECIFICATION SECTION	MANUFACTURER
Addressable Fire Alarm System	28 31 00	Simplex

PART 3 – EXECUTION (Not Used)

END OF SECTION 260505

SECTION 260506 - BASIC MATERIAL AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

1.2 DESCRIPTION OF WORK

A. Work included in this section consists of conduits, wires and other miscellaneous materials not specifically mentioned in other sections of Division 26, but necessary or required for equipment or system operation or function, and the labor to install them.

1.3 SUBMITTALS

A. Materials list with manufacturer, style, series or model identified.

B. Manufacturer’s descriptive literature and/or sample if requested by the Architect/Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Refer to Section 26 05 05.

2.2 CONDUIT RACEWAYS: Refer to Section 26 05 33.

2.3 WIRES AND CABLES: Refer to Section 26 05 19.

2.4 WIRING DEVICES: Refer to Section 26 27 26.

2.5 OUTLET BOXES, JUNCTION AND PULL BOXES

A. Outlet Boxes: Hot-dipped galvanized or sherardized of required size, 4” square minimum, for flush mounted devices and lighting fixtures. Cast-type FD with gasketed covers for surface-mounted devices.

B. Junction and Pull Boxes: Use outlet boxes as junction boxes wherever possible. Larger junction and pull boxes shall be fabricated from sheet steel, sized according to code, with screw-on covers, galvanized where required for outdoor exposure.

C. All exterior boxes shall be cast, gasketed, weatherproof type with cast covers.

D. Refer to Section 26 05 34 for additional requirements.

2.6 WIRE CONNECTORS

A. For wires that are #8 AWG and smaller: Insulated pressure type with live spring, rated 105°C, 600 volt, for building wiring and 1000 volt in signs or fixtures.

B. For wires that are #6 AWG and larger: Compression type with 3M #33 or equal tape insulation.

2.7 CONDUIT HANGERS

A. Galvanized steel with special accessories for purpose and adequate to support load imposed. Support individual conduit 1-1/2-inch and larger and all multiple conduit runs with hangers. Clamp conduits individually to each support.

B. Refer to Section 26 05 29 for additional requirements.

2.8 ACCESS PANELS

A. Electrical Contractor to provide access panels for electrical equipment which are required for accessibility by code.

2.9 CONDUIT SLEEVES

A. Sleeves for Conduit Penetration: Pipe Shields, Inc., model WFB at walls and QDFB at floors. Refer to Division 7 “Firestopping” for additional requirements.

2.10 EQUIPMENT MOUNTING AND SUPPORT HARDWARE

A. Steel channels, bolts and washers, used for mounting or support of electrical equipment shall be galvanized typed. Where installed in corrosive atmosphere, stainless steel type hardware shall be used.

B. Refer to Section 26 05 29 for additional requirements.

2.11 EQUIPMENT SUPPORTS

A. Provide housekeeping pads for all floor mounted equipment.

1. Housekeeping pads shall have a minimum height of 4” or as specified on the drawings, whichever is greater.
2. Provide pins to tie new pad to existing floor.
3. Provide rebar within new pad to support equipment load and prevent cracking of pad.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide complete raceway systems for all conductors including control wiring and low voltage wiring unless otherwise noted.

B. Electrical system layouts indicated on drawings are generally diagrammatic but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served. Take all dimensions from architectural drawings.

C. All home runs to panelboards are indicated as starting from the outlet nearest to the panel and continuing in the general direction of that panel. Continue such circuits to panel as though routes were completely indicated.

D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of the Architect and conform to all structural requirements when cutting or boring structure.

E. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc., required for equipment specified under this Section.

3.2 RACEWAY: Refer to Section 26 05 33.

3.3 OUTLETS

A. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc., with the Architect/Engineer.

B. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4” octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8” no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located on one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide tile box or a 4” square box with tile ring in masonry walls which will not be plastered or furred, or where “dry-wall” type materials are applied. Through the wall type boxes are not permitted. Install minimum 12” lateral separation for back to back boxes.

C. Surface-mounted devices are to be mounted in cast type boxes with gasketed covers: (Crouse-Hinds condulets or equal).

D. Dimensions, unless shown on drawings, are given below and are from finished floor to center line of outlets unless noted otherwise. Adjust heights of outlets in masonry walls to correspond with consistent brick or block course. Outlets in block walls shall be installed in core of block.

Wall Switches	4’ - 0” (to top of switch)
Convenience outlets	1’-6” (to bottom of outlet)
Receptacle outlets in mechanical spaces	3’ – 0” (to bottom of outlet)
Hallways	1’ - 6” (to bottom of outlet)
Workroom wall outlet	4’ - 4” (field verify height of backsplash)
Panelboards wall-mounted	6’ - 6” (to top of trim)
Wall phone outlet	4’ - 0”
Telephone outlets	1’ - 6”
Fire alarm horns, speakers	ceiling or wall
Fire alarm pull stations	4’ - 0” (to top of device)
Fire alarm strobes	6’ - 8” or 6” below ceiling(whichever is lower)
Receptacles at counters	4’-0” or as required.

Confirm final location and heights of all outlets, wall switches, and television outlets with architectural drawings and furniture plans prior to installation.

E. Outlets except over counters, benches, special equipment, baseboards, fin tube radiators, etc., or at wainscotting, shall be at a height to prevent interference to service equipment, or as noted on drawings.

F. Refer to Section 26 05 34 for additional requirements.

3.4 JUNCTION PULL BOXES

A. Construct junction or pull boxes not over 150 cubic inches in size shall be standard outlet boxes, and those over 150 cubic inches shall be constructed the same as “Cabinets,” with screw covers of same gauge metal. Removal covers must be accessible at all times.

B. Provide a standard access panel having a hinged metal door neatly fitted into a flush metal trim, where a junction box or equipment is located above non-accessible ceilings or behind finished walls. Coordinate location and type with the Architect.

END OF SECTION 260506

SECTION 260509 - ELECTRICAL DEMOLITION AND RELOCATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. The Architect shall decide which is most stringent.

B. Requirements of the following Divisions and Sections apply to this Section:

1. Division 26 Section 26 05 02 “Electrical Requirements.”
2. Division 9 Section “Painting” for related requirements.

C. Refer to other Division 26 Sections for additional specific electrical demolition or relocation associated with specific items.

1.2 SUMMARY

A. This Section includes basic requirements for demolition and relocation of electrical materials, equipment, and installations. The Contractor shall be responsible for visiting the site prior to bid to determine the actual conditions, which might affect the bid or contract price. No allowance will be made subsequently resulting from the neglect to visit the site and make such determinations.

B. Generally, electrical items that are to be replaced with other equipment in the same location is work covered by this section. Also covered by this section are electrical items that are to be removed in their entirety or that are to be relocated to another place.

1.3 PROTECTIVE MEASURES

A. Provide the following protective measures:

1. Wherever existing roofing surfaces are penetrated by electrical conduit, they shall be protected against water infiltration. Water leaks shall be repaired immediately upon discovery when they occur.
2. Temporary protection against damage for all portions of existing structures and grounds where work is to be done, materials handled, and equipment moved or relocated.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. The Contractor shall provide all equipment and materials necessary for the removal or relocation of electrical equipment.

B. Materials used in restoration or repairing work related to demolition and relocation shall conform in type, quality, and function to that of the original existing construction or as otherwise indicated.

2.2 DISPOSAL AND RETENTION [NOTE TO SPEC WRITER: EDIT THE LIST BELOW]

A. Materials and equipment resulting from work and removed from the building or structures, or parts thereof, shall become the property of the Contractor and shall be removed from the site by the Contractor except as follow:

1. Light fixtures, lamps, and ballasts.
2. Fire, heat, and smoke detection devices.
3. Telephones and telephone equipment other than outlet devices.
4. Fire alarm notification devices and pull stations.
5. Paging speakers, clocks, and intercom call stations.

B. Items removed or noted to be retained by the Owner but which are declined to be retained by the Owner shall be removed from the site by the Contractor.

C. Combustible waste material and rubbish shall not be stored or allowed to accumulate within a building or its vicinity, but shall be kept in a suitable trash container for subsequent removal or shall be removed from the premises as rapidly as practical.

PART 3 - EXECUTION

3.1 GENERAL

A. Disconnect, remove and/or relocate electrical material, equipment, devices, components, and other work noted and required by demolition or alterations in existing construction.

B. Where the drawings indicate that equipment is to be replaced or where other equipment requires the relocation of existing equipment, the existing equipment shall be removed or relocated as though it was specifically noted to be removed or relocated.

C. Provide new material and equipment required for relocated equipment.

D. Wherever electrical materials have been removed from surfaces of the building or structure, those surfaces shall be patched and repaired.

E. Remove, cut, alter, replace, patch, and repair existing work as necessary to install new work. Unless otherwise indicated or specified, do not cut, alter, or remove any structural members, ducts, piping, or service lines without approval of the Owner’s representative.

F. Existing work or equipment to be altered or extended and found to be defective shall be reported to the Owner’s representative before it is disturbed or any further work is performed on it.

G. Where electrical equipment is indicated to be removed or relocated, the work shall include the complete disconnection from its source, dismantling as necessary, and removal or installation

of all conduit, wires, cables, etc. Unless noted otherwise, wires shall be removed from conduits back to the last utilization device or to the panelboard. No wiring shall be removed that prevents operation of other equipment not scheduled or indicated to be removed.

H. Perform and schedule all demolition work with other trades and work of the contract as necessary for the efficient progress and flow of the work.

I. Remove conductors from existing raceways to be rewired. Clean raceways as required prior to rewiring.

J. Tape both ends of abandoned conductors, and cap outlets and abandoned raceways.

K. Cut and cap abandoned floor raceways flush with concrete floor or behind walls and ceilings.

L. Dispose of removed raceways and wiring.

M. Where any fixture or wiring device is removed, provide adequate size and type of blank plates over each outlet.

N. Dispose of removed electrical equipment as directed.

O. All electrical work in adjoining areas which is indicated on the Drawings to continue to function but is affected by demolition work shall be reconnected and restored to present function as part of the electrical system of the Buildings.

P. Connect new work to existing work in a neat and acceptable manner, with minimum interference to existing facilities.

Q. Maintain continuous operation of existing facilities affected by the work.

R. Alarm and emergency systems are to be interrupted only with the written consent of the Owner.

S. Temporary shutdowns when required, to be made only with written consent of Owner at times not to interfere with normal operations.

T. Where indicated on the Drawings or required by the alteration scheme, the Contractor shall remove all electrical outlets, switches, and other devices, complete with associated wiring, conduit, etc., from partitions, walls, and floors that are to be removed. When the removal of these makes dead electrical wiring that is to remain, Contractor shall install junction boxes or other devices necessary to make the circuits affected continuous and ready for operation. Otherwise, wiring shall be removed back to the nearest electrical outlet box that is to remain, or to the panelboard.

U. All raceways which become exposed beyond finished surfaces because of the alteration work shall be removed and rerouted behind finished surfaces.

V. Wiring that is to be removed as a result of demolition work, but is required to continue to function, shall be interrupted at convenient locations, rerouted (new wiring and conduits) and reconnected for continuation of their original function. New wiring extensions shall match existing ones in all respects, conductor ampacity, conduit size, etc.

END OF SECTION 260509

SECTION 260510 - PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Certifications
5. Record drawings
6. Permit requirements

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the electrical and technology systems.

B. Within 30 days of the first major milestone submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary - Electrical

☐ The following tests have been completed. Submit test report for record.
- ☐ Feeder Testing and Reporting (Megger Result)
- ☐ Transformers Testing and Reporting
- ☐ Grounding System Testing and Reporting

☐ All main components of the electrical system cleaned and vacuumed. This includes distribution boards, panel boards, etc. Provide ME Engineers with schedule when this is going to occur and a letter stating it has been completed.

☐ The contractor shall schedule a walk through with the engineer to inspect all main feeder sizes. Covers for panel boards and distribution boards should be removed by the contractor for visual inspection of feeder sizes.

☐ Temporary cable tray hooks inspected.

☐ The fire alarm system manufacturer shall provide the Owner/Architect with a “Letter of Certification” indicating the system is fully functional and meets all manufacturers requirements as well as code and design requirements. Fire department must sign off the system.

☐ Panelboard directories completed.

☐ Record drawings submitted.

☐ All lighting control systems complete with controls fully operational for visual inspections.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 LIFE SAFETY SYSTEMS

A. All life safety systems shall be fully and successfully tested by the contractor before being witnessed by the engineer or building official.

B. The contractor shall provide a detailed test procedure, with instrumentation to be used, for approval by the engineer and building official prior to any testing.

C. Once tested by the contractor and fully operation the systems shall be demonstrated to the engineer. Once accepted by the engineer the system shall be demonstrated to the building and fire officials.

3.3 COORDINATION WITH OTHERS

A. The Division 26 contractor shall coordinate his requirements with the general contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 26, 27 and 28 systems.

3.4 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION 260510

SECTION 260519 - WIRES AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirement of the following Division 26 Sections apply to this section:

1. Electrical Requirements

1.2 SUMMARY

A. This Section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600 volts and less.

B. Related Sections: The following Sections contain requirements that relate to this section:

1. Division 26 Section “Electrical Boxes and Fittings” for connectors for terminating cables in boxes and other electrical enclosures.

C. The work includes providing wire and cable complete with all accessories in accordance with Drawings and Specifications and as required for a complete system. Wiring size referenced in this Section shall be AWG, except as noted. For special wiring for individual systems refer to respective Section of these Specifications.

1.3 SUBMITTALS

A. Product Data for electrical wires, cables and connectors.

B. Shop drawings shall include detail drawings and data sheets for all wire and cable, compression wire connectors, large aluminum wire connectors, and large copper wire connectors.

C. Cable Pulling Submittals:

1. The following requirements pertain to all 600 volt or less feeders, sized 4/0 AWG or larger that are either in excess of 200 feet or requiring more than 180° of bend:
2. The Contractor shall utilize a pulling calculation software package, such as Polywater Cable Management Software or SKM Cable Pulling Analysis Software, to model and determine the expected pulling tensions and sidewall pressures that the conductor(s) will be exposed to. If the calculations determine that the expected pulling tensions and sidewall pressures will exceed the manufacturer's recommended values, the contractor is responsible making modifications necessary to correct the problem and re-run the analysis. Contractor shall submit the results of the analysis for the intended conduit routing prior to commencement of cable pulling for engineer’s approval. If the intended conduit routing is modified due to engineers comments or coordination with the other trades the contractor must re-run the analysis and resubmit for approval.
3. Contractor to submit detail conduit routing drawings showing pulling set ups and direction of cable pulls. These drawings shall clearly detail the intent of the cable pulls with reference to cable pull models. Indicate all splice locations for approval by engineer and owner.

4. Submit wire manufacture’s maximum pulling tension and sidewall pressure recommendation.
5. Submit cable pulling machine for approval.
6. Submit UL listed pulling lubricants for approval.
7. Utilize Tensiometer similar or equal to, Condux Running Line Tensiometer, CableGlider HD.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following code:

B. NFPA 70 “National Electrical Code.”

1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
2. Comply with most restrictive code.

C. UL Compliance: Provide components, which are listed and labeled by UL under the following standards.

1.	UL Std. 44	Rubber Insulated Wires and Cables
2.	UL Std. 83	Thermoplastic-Insulated Wires and Cables
3.	UL Std. 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
4.	UL Std. 854	Service Entrance Cable

D. NEMA/ICEA Compliance: Provide components which comply with ANSI/NEMA WC 70-2009 / ICEA S-95-658-2009.

E. IEEE Compliance: Provide components, which comply with the following standard.

1. Std. 82: Test procedures for Impulse Voltage Tests on Insulated Conductors.

F. QUALITY ASSURANCE

1. "Manufacturers" - Firms regularly engaged in manufacture of wire and cable of types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
2. Provide wire and cable which has been listed and labeled by Underwriters' Laboratories, and comply with applicable portions of National Electrical Manufacturers Association Standards.
3. Provide wire and cable produced by a manufacturer listed as an Approved Manufacturer in this section.
4. Provide equipment whose performance under specified conditions, is certified by the Manufacturer.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES (600 VOLT COPPER CONDUCTORS)

A. General: Provide suitable wire and cable for the temperature, conditions and location where installed. All wires and cables shall be new and delivered to the site in unbroken packages and reels.

B. All wires and cables shall be of the same manufacturer throughout the entire project.

C. Conductors:

1. Provide solid conductors for power and lighting circuits #10 AWG and smaller. Provide stranded conductors for #8 AWG and larger.
2. Minimum conductor size shall be No. 12 for lighting and power and No. 14 for control and alarm. Increase wire as noted hereinafter for long runs.
3. Communications and signal wiring shall conform to the recommendations of the manufacturer's communication and signal systems and shall be as specified in respective Sections of these Specifications.

D. Conductor Material: All wires and cables shall be copper, single conductor rated at 600 volts, which conform to or exceed ICEA specifications. Use XHHW-2 or THWN-2/THHN, UNO.

1. Emergency system feeders shall either be a listed 2-hour cable paired with listed conduit, MI cable, or encased in minimum of 2 inches of concrete.

E. Grounding conductors: Shall be of the same type as its associated phase conductors.

F. All conductors shall be label with wire size, insulation rating, etc using an engraved process. Computer scan or labels are not permitted.

G. Color Coding for phase identification in accordance with Table 1 in Part 3 herein.

1. Where color-coded cable is not available, certify in writing and request permission for overlap color taping conductors (minimum length 6 in.) in accessible locations.
2. Conductors for control circuits and signal systems shall also be consistently color coded to avoid confusion and permit easy identification of conductors. The IPCEA color code shall be used wherever possible. No two wires in the same raceway shall be the same color, unless provided with flameproof linen identification tags on each end.

H. Connectors for Conductors:

1. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.
2. For wires that are #8 AWG and smaller: Insulated pressure type with live spring, rated 105°C, 600 volt, for building wiring and 1000 volt in signs or fixtures.
3. For wires that are #6 AWG and larger: Compression type with 3M #33 or equal tape insulation.

I. Splices and Taps:

1. No. 10 AWG and smaller - Connectors for solid conductors shall be solderless, screw-on, spring pressure cable type, 600 volt, 105°C with integral insulation and UL approved for aluminum and copper conductors. Connectors for stranded conductors shall be crimp-on type with integral insulating cover.
2. No. 8 AWG and larger - Hydraulically applied crimping sleeve or tap connector sized for the conductors. Insulate the hydraulically applied connector with 90-degree, 600-volt insulating cover provided by the connector manufacturer. Insulator materials and installation shall be approved for the specific application, location, voltage, and temperature and shall not have an insulation value less than the conductors being joined.

J. Wire Sizes

1. For General Use:
   a. No. 12 minimum copper wire shall be used for lighting and power.
   b. No. 10 minimum copper wire shall be used at 120 volts and over 90 ft. for 15 amp circuit and 60 ft. for 20 amp circuit length.
   c. No. 10 minimum copper wire shall be used at 265 volts and over 175 ft. circuit length.
2. For Control and Alarm (unless otherwise noted):
   a. No. 14 minimum copper wire shall be used.
   b. No. 12 minimum copper wire shall be used at 120 volts and over 60 ft. circuit length.

3. For Other Voltages and Phases and for Longer Circuit Lengths:
   Size wire as required to maintain equivalent voltage drop.

4. Raceways: Increase raceway sizes for larger wire as required.

K. Insulation:

1. Rubber and thermoplastic insulation shall comply with ASTM and IPCEA standards. Paper and lead insulation shall comply with AEIC standards.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Use the following wiring methods as indicated:

1. Install all wire in raceway. Power and control wiring shall be installed in separate raceways.

3.2 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Coordinate cable and wire installation with other Work.

C. Wire and cable shall not be drawn into conduit and raceways until all conduit work is complete - joints made up tightly and the entire run secured in place.

D. Do not install more conductors in a raceway than indicated on the drawings. A maximum of six branch circuits are to be installed in any one conduit on a 3-phase, 4-wire system, unless specifically noted otherwise on the drawings. When more than three branch circuits are installed in a raceway, the conductor size shall be increase per code for derating.

E. Minimum wire size shall be a No.12 AWG except for control or signal circuits, which may be No. 14 AWG.

F. Unless otherwise indicated on drawings, all wiring for branch circuits shall be a minimum No. 12 AWG in ¾" conduit, protected by 20 amperes circuit breakers.

G. Size of current carrying conductors, unless noted otherwise on drawings, shall be determined from Table 310-16 of the latest National Electric Code for the load served.

H. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

I. Care shall be exercised in pulling to avoid damage to the wire or cable. Lubricants shall be used for pulling wire or cable if the character of the pull would otherwise damage the conductors, insulation or jacket. Pull no thermoplastic wires at temperatures lower than 0EC.

J. Use pulling means including: fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

K. Size of conduits, unless specifically shown, shall be determined from Appendix C of the latest National Electrical Code.

L. Keep conductor splice to minimum. All splices shall be made within junction boxes, wiring troughs and other enclosures as permitted by the National Electrical Code. Do not splice conductors in panelboards, safety switches, switchboard, motor control centers or motor control enclosures. Splices in conductors installed below grade will not be permitted, unless approved in writing by the Architect.

M. Install splice and tap connectors, which possess equivalent or better mechanical strength and insulation than conductors being spliced.

N. Use splice and tap connectors which are compatible with conductor material.

O. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

P. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturers' published torque tightening values. Where manufacturers' torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque values specified in UL 486A and UL 486B.

Q. 600 Volt Wire and Cable:

1. The inside of conduits and raceways shall be dry and clean before wires are pulled.
2. Cables shall be supported at the upper end of all risers and at intermediate points as required by the NYC Code or NEC (whichever is more stringent). Supports shall be O.Z. Type "R" or approved equal, insulation wedges or Kellems grips.
3. Wire and cable shall be installed in accordance with manufacturer's instructions.
4. Cable spacers shall be installed where required. Spacers shall be conduit fittings for spacing of cables at terminations and shall consist of galvanized or cadmium plates, steel or malleable iron threaded conduit and fittings and inserts of non-metallic insulating material with openings adequate to accommodate cables being spaced. Cable spacers shall be adequate to accommodate cables being spaced. Cable spacers shall be O.Z. Mfg. Co., Inc. Type E or Type EL with grounding lug or approved equal.
5. Provide separate raceways for conductors of 120/208 and 277/480 volt systems.
6. Install cable limiters at each end of each conductor of more than three (3) paralleled conductors per phase, over 100 ft. in length. Limiters shall be rated 600 volts, 200,000 amps RMS interrupting capacity and shall have waterproof sleeves.
7. Thermoplastic wires shall not be installed in computer area raised floors.
8. Provide individual raceways for two pole ungrounded circuits.

9. In certain systems, equipment furnished by an approved manufacturer may require a different number and arrangement of conductors from that indicated on the Drawings. In such cases, the Contractor for the work under this Division shall comply with such requirements at no additional cost to the Owner.
10. In the event the Contractor for the work under this Division or Section chooses to furnish and install a system or item of equipment of different arrangement from that shown or specified, he shall furnish and install any additional wiring and conduit required by the system at no additional cost to the Owner.
11. In wireways and large pull boxes, lace and tie off conductors in groups of 3 phases and neutral (if used) to limit conductor unbalanced loading. Conductor group shall be as installed in conduits.
12. Tag all feeders and risers in all pull boxes and in all gutter spaces through which they pass. Tags shall be engraved white core nameplates identifying feeders as shown on the Drawings or the circuit protective device from which they originate.
13. Leave all wires with sufficient slack at terminals ends for convenient connections and fixtures and for convenient servicing. Stow loose ends neatly in outlet box.
14. Splices and taps shall be made in accessible boxes, panelboards fittings, gutters, terminal panels, etc. only. Materials shall be compatible with the conductors, insulations and protective jackets on the cables and wires.
15. All copper conductors No. 8 & larger shall be spliced, and tapped with color-keyed compression connectors, as manufactured by Thomas & Betts Co., Series 54000, Ideal Industries Series 87000, or approved equal. The manufacturers recommended tooling shall be used. Mechanical type connectors shall not be used. All copper conductors No. 8 and larger shall be terminated with self crimping, self adjusting, spring action type cable terminators, as manufactured by CYTOLOK or approved.
16. All copper conductors No. 10 AWG & smaller shall be terminated and spliced with Ideal Industries wing-nut wire connectors, or approved equal compression connectors. The nylon self-insulated type shall be used to isolate the terminal from other metal parts and equipment.
17. Splices and joints shall be insulated with materials approved for the particular use, location, voltage, and temperature. Insulation shall be not less than that of the conductors being joined.
18. Plastic electrical insulating tape shall be flame retardant, cold and weather resistant.
19. All circuit and control wiring in cabinets, panels, pullboxes, and junction boxes shall be tied and held with nylon Ty-Rap cable ties as manufactured by Thomas & Betts Co. or approved equal.
20. Wire identification ties fastened to conductors at the point of attachment to terminal blocks and equipment components shall be nylon, self-locking Ty-Raps as manufactured by Thomas & Betts Co., Series Ty-51M, 53M, or approved equal.
21. Cables shall be tagged in all pull boxes, wireways and wiring gutters of panels. Where two or more circuits run to or through a control device, outlet box or junction box, each circuit shall be tagged as a guide in making connections.
22. Tags for feeders shall indicate feeder number, size, phase, voltage, origin and termination. Feeder tags shall identify all phases individually.
23. Tags for control and alarm wiring shall indicate type of control or alarm, size of wire and origin and termination.
24. Tags shall be Thomas Betts Co., Ideal Industries wire-marker dispenser type, self-laminated wire markers.
25. Wire lubricating compound shall be suitable for the wire insulation and conduit with which it is used, and shall not harden or become adhesive. Lubricating compound shall be Ideal Industries, Type Yellow 77, or approved equal. Lubricating compound shall not be used on wire for isolated type electrical power systems.
26. Contractor shall examine the areas and conditions under which wire and cable are to be installed, and notify Architect in wiring of conditions detrimental to proper and timely completion of the work.

27. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.

B. Prior to energizing, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

D. Prior to completion of project, an infrared scan of switchgear and panelboard feeder equipment connection shall be performed when all loads are energized.

E. TABLE 1: Color Coding for Phase Identification:

1. Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

208V/120 Volts	Phase	480V/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

3.4 FEEDER TESTING

A. Products

1. Material: Contractor shall provide all necessary testing equipment and devices required to perform the test described in this section.

B. Execution

1. Visual and Mechanical Inspection
   a. Inspect cables for physical damage and proper connection in accordance with one-line diagrams.
   b. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
   c. Check cable color coding with Table I in this section and National Electrical Code standards.
2. Electrical Tests
   a. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts dc for 1 minute.
   b. Perform continuity test to insure proper cable connection.
   c. Megger conductors phase-to-phase and phase-to-ground for continuity and insulation tests before connection to utilization devices for the following:
      1. 100 percent of feeders.
      2. 10 percent of branch circuits.
      3. 100 percent of 3-phase motor branch circuits.

d. Verify phase rotation for all three-phase motor circuits.

3. Test Values
   a. Evaluate results by comparison with cables of same length and type. Investigate any values less than 50 megohms.
   b. Submit results to Engineer for approval in accordance with Section 26 05 02 and 26 05 03.

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Materials and Methods sections apply to work of this section.

C. Requirements of this section apply to electrical grounding and bonding work specified elsewhere in these specifications.

1.2 SUMMARY

A. Extent of electrical grounding and bonding work is indicated by drawings and schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.

B. Type of electrical grounding and bonding work specified in this section includes the following:

1. Solidly grounded.

C. Applications of electrical grounding and bonding work in this section includes the following:

1. Building frames - structural steel.
2. Electrical power systems.
3. Grounding electrodes.
4. Separately derived systems.
5. Raceways.
6. Enclosures.
7. Equipment.
8. Lighting Standards.

D. Refer to other Division-26 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work; not work of this section.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on grounding and bonding products and associated accessories.

B. Shop drawings shall include splice kits and ground wire.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including

stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 10 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience on projects with electrical grounding work similar to that required for project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
2. UL Compliance: Comply with applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Std 486A, "Wire Connectors and soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
3. IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
4. For patient care area electrical power systems, grounding shall conform to Article 517 of the NEC.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and Components:

1. Provide electrical grounding and bonding system; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is installer's option. Where materials or components are not indicated provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications indicated.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductors, 1/3 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 5 AWG, stranded conductors.

6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Rectangular bars of annealed copper (1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by Cadweld (or approved equal) manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

A. Grounding wires shall be UL and NEC approved types, copper, with insulation color identified green, except where otherwise shown on the Drawings, or specified.

PART 3 – EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No.10 AWG and smaller, and stranded conductors for No.8 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. The conduit shall not be acceptable as an equipment ground.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase appliance branch circuits.

5. Three-phase appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, dampers and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

3.3 EXAMINATION

A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.4 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

A. General: Install electrical grounding and bonding systems in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

G. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

H. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

I. Install all connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

J. The complete electrical installation shall be permanently and effectively grounded before the water meter and grounded in accordance with all code requirements, whether or not such connections are specifically shown or specified. Measured resistance to ground shall be 5 ohms. maximum.

K. Parts of the electrical installation to be grounded shall include, but not be limited to, the following: conduit system for light and power, cabinets, housings and neutrals of transformers, motor frames, housings of alarm and control panels and associated devices, lighting fixtures, emergency distribution system, telephone system, fire alarm system, smoke detection system, communications and security system, individual starters and other non-current carrying metal parts of electrical equipment.

L. All copper bars for grounding shall be medium hard drawn. After installation, the copper bar shall be painted with one coat of an approved lacquer.

M. Ground conductors shall be of sizes and material in accordance with the requirements of the National Electrical Code. Cable for grounding connections shall be bare in accordance with the latest revisions of ASTM Designations B3 and B8. All open bare grounding cable shall be secured in place with cast and honed malleable clamps and clamp backs, and 1/4 inch bolts.

N. Ground wires shall be continuous without splices. There shall be no soldered joints in any ground connection. Connectors, clamps, etc. shall be solderless type.

O. Ground interrupted metallic raceways with ground conductors connected to metallic raceway at each end.

P. Separately ground center taps of wye connected transformers in accordance with National Electrical Code (NFPA 70).

Q. For hospitals and Health Care Facilities, provide all grounding in accordance with Article 517 of National Electrical Code (NFPA 70) and as further described in these Specifications.

R. Where ground connections will be permanently concealed, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connections.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

B. Inspect all connections prior to concealing same.

PART 4 – APPROVED MANUFACTURERS

A. For ground rods.

1. Carolina Galvanizing.
2. Weaver Electric

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this section:

1. “Electrical Requirements.”

1.2 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. Related Sections: The following Sections contain requirements that related to this Section:

1. Division 3 Section “Mild Steel Concrete Reinforcement” for inserts, anchors, and sleeves to be installed in concrete for use with supporting devices.
2. Division 5 Section “Metal Fabrications” for requirements for miscellaneous metal items involved in supports and fastenings.
3. Division 7 Section “Firestopping” for requirements for firestopping at sleeves through walls and floors that are fire barriers.
4. Refer to Division 26 Sections for additional specific support requirements that may be applicable to specific items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.

1. Hanger and support schedule showing manufacturer’s figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

C. Shop drawings indicating details of fabricated products and materials.

D. Engineered Design consisting of details and engineering analysis for supports for the following items:

1. Conduit (racked)
2. Ceiling mounted boxes.
3. Conduit - Ceiling mounted.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with local codes as well as NFPA 70 “National Electrical Code.”

B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

C. Installation shall comply with local authorities’ seismic requirements.

PART 2 - PRODUCTS

2.1 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.2 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

D. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

E. U-Channel Systems: 16-guage steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.3 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with local codes and NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with local codes, the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼-inch diameter or larger threaded steel. Use spring fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceway in accordance with NEC.
7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, supports at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples of threadless box connectors.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors (i.e., strain reliefs).

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to the raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

G. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and wall for raceways and cable installations. For sleeves through fire-rated wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with “Fire Stopping” requirement of Division 7.

H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions or light steel construction, use sheet metal screws.
2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than ¾ inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

J. TESTS: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

1. Expansion anchors.
2. Toggle bolts.

Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer’s approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

NOTES:

1. Maximum spacing of supports (feet).
2. Maximum spacing for IMC applies to straight runs only. Otherwise the maximum of EMT applies.
3. Support for cable tray shall be as directed in their respective sections.

END OF SECTION 260529

SECTION 260533 - RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Requirements of the following Division 26 Sections apply to this Section:

1. “Electrical Requirements.”

1.2 SUMMARY

A. This Section includes raceways for electrical wiring. Types of raceways in this section include the following:

1. Rigid metallic conduit (RMC).
2. Intermediate metal conduit (IMC).
3. Electrical metallic tubing (EMT).
4. Flexible metal conduit (FMC).
5. Liquid-tight flexible conduit (LFMC).
6. Rigid aluminum (RA).
7. Metal clad cable (MC).
8. Wireway (WW).
9. Surface metal raceways (SMR).

B. Related Sections: The following section contains requirements that relate to this section:

1. Division 26 Section “Electrical Boxes and Fittings” for conduit connectors, fittings, and couplings.
2. Division 7 Section “Firestopping” for conduit penetrations through rated walls and slabs.
3. Division 28 Section “Fire Alarm”.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of contract and Division 1 Specification Section.

B. Product Data for the following products:

1. Raceways and fittings.
2. Wireways and fittings.
3. Boxes and fittings.
4. Color selection chart for wallplates.

C. Installation Instructions: Manufacturer’s written installation instructions for wireway, surface raceway, and nonmetallic raceway products.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

B. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

C. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL.

D. Manufacturers - Firm regularly engaged in manufacture of raceways of types and capacities required and whose products have been in satisfactory use in similar service for not less than 5 years.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1

1. Shall be full weight steel pipe, hot dip galvanized inside and outside, threaded, minimum 3/4 inch.
2. Shall be painted with two protective coats of asphaltum compound where located below slab.

B. Intermediate Steel Conduit: UL 1242.

1. Shall be intermediate weight steel pipe, hot dip galvanized, threaded, minimum 3/4 inch.
2. Shall be painted with two protective coats of asphaltum compound where located below slab.

C. Electrical Metallic Tubing and Fittings: ANSI C80.3.

1. Shall be thin wall steel pipe, galvanized, thread-less, minimum 3/4 inch. EMT shall not be used for cable rated above 600 volts.

D. Flexible Metal Conduit: UL 1, zinc-coated steel.

1. Shall be continuous single strip, galvanized, minimum 3/4 inch.

E. Liquid-tight Flexible Metal Conduit and Fittings: UL 360.

1. Liquid-tight, flexible steel, conduits shall be zinc coated flexible galvanized steel tubing over which is extruded a liquid- tight jacket of polyvinyl chloride (PVC). Conduit shall be provided with a continuous copper bonding conductor wound spirally between the convolutions.

F. Rigid Aluminum Conduit:

1. Rigid aluminum conduit shall be full weight pipe, threaded, minimum ¾ inch.

2.2 METAL CLAD CABLE, TYPE MC

A. The multi-conductor metal clad cable shall comply with UL 1569 “Metal Clad, Type MC,” UL 83 “Thermoplastic Insulated Wires and Cables” Federal Specification J-C-30B “Wire and Cable,” Local and National Electrical Codes.

B. The metal clad cable shall be THHN insulation, copper conductors in sizes #12 through #8 AWG only for continuous operation at a maximum conductor temperature of 90 degree C dry.

C. These cables shall bear appropriate Underwriters Laboratories labels for metal clad cable and be suitable for use as branch circuits in both concealed, and very limited exposed work, in accordance with applicable sections of the National Electrical Code.

D. An insulated grounding conductor sized in accordance with Table 5.3 Underwriter’s Standard UL 1569 shall be cabled with the circuit conductors and shall be identified in compliance with Section 29 of UL 1569. The grounding conductor shall not be smaller than size indicated in NEC Article Table 250.122.

E. A galvanized steel or aluminum armor shall be applied over the inner cable assembly with a positive interlock in compliance with Section 10 of UL 1569. A PVC jacket shall completely cover the steel or aluminum armor where liquid tight flexible metal conduit is required.

2.3 CONDUIT BODIES AND FITTINGS

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

1. Metallic conduit fittings shall be corrosion resistant.

C. EMT Conduit Bodies: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.

1. Material shall be steel or malleable iron only.
2. Couplings and connectors shall be "concrete tight" or "raintight", couplings and connectors for conduit sizes 2-inch and smaller shall be of the gland and ring compression type. Connectors shall have insulated throats.
3. Set screw or indent type connectors are not permitted. Compression waterproof connection type fittings only shall be utilized.

D. Nonmetallic Conduit: Use nonmetallic conduit bodies conforming to UL514B.

E. Liquid-Tight Flexible Conduit Fittings: With threaded grounding cone, a steel, nylon or equal plastic compression ring, and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without O-ring seal. Each connector shall provide a low resistance ground connection between the flexible conduit

and the outlet box, conduit or other equipment to which it is connected.

F. Bushings: Insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system, for rigid steel conduit and IMC – and EMT, larger than ¾" size.

1. Bushings shall be of the metallic insulated type.

G. Expansion Fittings: Each conduit that is buried in or secured to the buildings construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings for rigid steel conduit shall be hot-dipped galvanized malleable iron with factory installed packing and a grounding ring. Expansion fittings for rigid non-metallic conduit shall be of the short type in runs 25' or less, and the long type in runs 26' to 80'. The long type shall be a two piece barrel and piston joint, providing 6" of the total movement range in ¾" through 6" conduit sizes. The short type shall be a one piece, coupling with O-ring, providing 2" of total movement range in ¾" to 2" conduit sizes.

1. Shall comply with UL 467 and UL 514 and shall accommodate, 0.75 inch deflection, expansion, or contraction in any direction, and shall allow 30 degree angular deflections.
2. Shall include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC tables for ground conductors.
3. Shall be watertight, seismically qualified, corrosion- resistant, threaded for and compatible with rigid or intermediate metal conduit.
4. Jacket shall be flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

H. Seal Off Fittings: Threaded, zinc or cadmium coated, cast or malleable iron type for steel conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

I. For weatherproof and dust-tight installations provide liquid-tight fittings with sealing ring and insulated throat.

J. Rigid steel and IMC conduit fittings:

1. Fittings shall be standard threaded couplings, locknuts, bushings, and elbows. Material shall be steel or malleable iron only.
2. Locknuts shall be of the bonding type with sharp edges for digging into the metal wall of an enclosure.
3. Bushings shall be of the metallic insulating type, and shall consist of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
4. Sealing fittings shall be of the threaded cast iron type. Sealing fittings used to prevent passage of water vapor shall be of the continuous drain type. In concealed work, each fitting shall be installed in a flush steel box with blank coverplate having the same finish as that of other electrical plates in the room.

K. Rigid aluminum conduit fittings:

1. Fittings shall be standard threaded couplings, locknuts, bushings, and elbows. Material shall be malleable iron, steel or aluminum alloy. Iron or steel fittings shall be zinc or cadmium plated. Aluminum fittings shall not contain more than 0.4 percent copper.

2. Locknuts and bushings shall be as specified for rigid steel and IMC conduit.
3. Set screw fittings shall not be used with aluminum conduit.

L. Surface metal raceway fittings shall be as recommended by the raceway manufacturer

M. Flexible steel conduit (Greenfield) fittings:

1. Material shall be steel or malleable iron only.
2. Shall be multiple point type, threading into the wall of the conduit convolutions, and shall have insulated throat.

2.4 WIREWAYS

A. General: Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC. Wireways shall be steel and of sizes noted and shall have a minimum of No. 16 gauge thickness.

B. Wireway covers shall be hinged type.

2.5 SURFACE METAL RACEWAYS

A. General: Sizes and channels as indicated. Provide fittings that match and mate with raceway. Provide internal barriers for areas with power and communications sections. Shall be steel with baked enamel finish, of sizes noted, and a minimum of No. 20 gauge thickness.

B. Surface Metal Raceway: Construct of two piece galvanized steel with snap-on covers, with 9/32-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer’s standard prime coating suitable for painting. Provide raceways of types suitable for each application required. Sizes 1-3/4” H x 4-3/4” W.

C. Provide labeling for each outlet with panel and circuit number where multi-outlet raceways are utilized.

D. Accessories:

1. Couplings for joining raceway sections.
2. Wire clips for conductors.
3. Blank end fittings.
4. Circuit breaker housings for single pole breakers.
5. Device brackets for single or two gang devices.
6. Combination receptacle and telephone outlet covers.
7. Outlet boxes with hubs for conduit connectors.

E. Covers for the surface metal raceways shall be snap-on type, unless otherwise noted.

2.6 CONDUIT SUPPORTS:

A. All parts and hardware shall be zinc-coated or have equivalent corrosion protection.

B. Individual conduit hangers shall be designed for the purpose, with pre-assembled closure bolt and nut, and provisions for receiving hanger rod.

C. Multiple conduit (trapeze) hangers shall be of not less than 1-1/2 by 1-1/2 inch, 12 gage steel, cold formed, lipped channels. Hanger rods shall be not less than 3/8-inch diameter steel.

D. Solid masonry and concrete anchors shall be a type approved for the purpose.

2.7 SLEEVES

A. Provide and assume responsibility for locating and maintaining in proper position all sleeves required for the work.

B. For raceways in sleeves, provide seals of oakum packing and lead or O.Z. Type WSK series compound on both sides.

C. For cables through sleeves, provide seals similar to O.Z. Type WSCS compound.

D. Through floors, exterior masonry walls, sleeves shall be schedule 40 galvanized steel pipe. For area not requiring schedule 40 pipe, sleeves shall be 18 gauge galvanized steel pipe.

2.8 FIRE SEALANTS

A. Openings through floors and walls in which cables, conduits, or pipe pass shall be sealed by U.L. classified smoke and fire stop fittings, and have an hourly rating equal to the fire rating of the floor or wall. Fittings shall be similar to O-Z Gedney Type "CES" or "CAFS".

B. Penetrations through fire-rated floors in which wiring for floor service outlets are routed shall be sealed by U.L. classified smoke and fire-stop fittings, and shall have an hourly rating equal to the floor rating. Fittings shall be similar to O-Z Gedney Type "PTFS".

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Use the following wiring methods:

USES	TYPE						
	RMC	IMC	EMT	FMC	LFMC	RA	MC
Indoor 600 volts and above concrete encased.	X						
Indoor exposed below 10 feet to floor in “back of house” spaces such as mechanical, electrical, basements, attics, etc.	X	X					
Indoor exposed below 10 feet, other than back of house spaces			X				
Indoor exposed above 10 feet to floor.			X			X	

Indoor concealed homerun to panelboards and for branch circuits.			X				
Indoor concealed final branch wiring to receptacles and light fixture. Max 50' length from homerun j-box to outlet. Not permitted for isolated ground circuits, homeruns to panels, or connections to mechanical equipment.							X
Indoor final connection to vibrating equipment: xfrms, solenoids, motors, etc. in dry areas				X			
Indoor final connection to vibrating equipment: xfrms, solenoids, motors, etc., in moist, humid, wet, or corrosive areas.					X		
Within concrete slabs, or connections to cast-in-place floor boxes. Maximum sizes and locations of conduit subject to approval by Structural engineer and Architect	X	X					
Fire Alarm initiating circuits and signaling circuits.			X				

B. In health care facilities, wiring of emergency systems shall be mechanically protected per NEC 517.30(C)(3). Flexible raceways are not permitted except as allowed in the exceptions of the referenced code section.

3.2 INSTALLATION

A. General: Install electrical raceways in accordance with manufacturers' written installation instructions, applicable requirements of NEC, and as follows.

B. Conceal conduit and EMT, unless indicated otherwise, within finished wall, ceilings, and floors. Keep raceways at least 12 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

C. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.

D. Complete installation of electrical raceways before starting installation of conductors within raceways.

E. Provide supports for raceways as specified elsewhere in Division 26 and in accordance with NEC and local authorities' seismic requirements.

F. Prevent foreign matter from entering raceways by using temporary closure protection.

G. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab. All elbow penetration through the slab shall be PVC coated rigid metallic conduit Ells.

H. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

I. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.

J. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

K. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. All exposed conduit runs shall be approved by the Architect prior to installing.

L. All exposed conduits in public areas shall first be approved to be routed in public areas, then be painted to match surrounding walls. Verify exact color with the Architect.

M. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases, provide field bends for parallel raceways. All exposed conduit routing shall be approved by the Architect prior to installing.

N. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Use expansion fittings at building expansion joints.

O. Tighten set screws of threadless fittings with suitable tool.

P. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with concave side against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside of the box. All conduit connections to junction boxes shall have insulated bushings.

Q. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

R. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave no less than 12 inches of slack at each end of the pull wire.

S. Telephone and Signal System Raceways: In addition to the above requirements, raceways 2-inches and smaller, shall have a maximum length of 150 feet with a maximum of two 90° bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.

T. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings

at the following points and elsewhere as indicated:

1. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, air-conditioned spaces and walk-in coolers.
2. Where required by the NEC.

U. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.

V. Flexible connection: Use length (maximum of 6 ft.) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement. Install separate equipment grounding conductor across flexible connections.

W. PVC externally coated rigid steel conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.

X. Grounding: Install a separate green equipment grounding conductor in all raceways from the panelboard/junction box supplying the raceway to the receptacle or equipment ground terminals. Conduits will not be permitted as a ground conductor.

3.3 RACEWAYS

A. Install conduit and tubing products as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation", and in accordance with the recognized industry practices to ensure that products serve intended function.

B. Run raceways concealed, except as noted. Exposed raceways shall be run parallel with or at right angles to walls.

C. Raceways supports shall be provided by means of ceiling trapeze, strap hangers, or wall brackets, structural steel angles or channels. Provide U-bolts at each floor level or riser raceways and connected to acceptable supports. Secure raceways to supports with pipe straps or U-bolts. Spacing of support shall be as per NEC and per manufacturer's recommendations.

D. Mount supports to structure with toggle bolts on hollow masonry, expansion shields or inserts on concrete and brick, machine screws on metal, wood screws on wood. Nails, rawl plugs or wood plugs are not permitted.

E. Provide a 12 in. minimum separation between raceways and steam and hot water pipes. Provide approved thermal insulation for electric lines where this separation cannot be maintained.

F. Keep raceways clear of motor foundations and from underside of boilers. Also, install raceway so that they will not obstruct headroom, doorways, or walkways.

G. For outlets located in hung ceilings, run raceways in hung ceilings and support from structure above. For lay-in ceilings, install conduits high enough to permit removal of ceiling tiles.

H. In walls, run raceways vertically only.

I. Mechanically join all metal raceways, enclosures and junction boxes to form a continuous electrical conductor. Connect all electrical boxes, fittings and cabinets so as to provide effective electrical continuity and firm mechanical assembly. Maintain grounding continuity of interrupted metallic raceways with ground conductor.

J. Install complete conduit runs before pulling in wire or cable. Install raceways so that required conductors may be drawn in without injury or excessive strain to raceway or cable. Where raceway size is not indicated, follow applicable code.

K. Do not cross pipe shafts or ventilation duct openings with raceway. Route raceway to avoid present or future openings in floor, wall or ceiling construction, when so indicated on the drawings.

L. Keep end of raceways plugged or capped during construction.

M. For empty raceways over 10 ft. long, provide fish or pull wire. Pull wire shall consist of steel core nylon rope and terminal ball.

N. Damaged or deformed raceway is not permitted and shall be removed.

O. Branch circuit conduits shall not be supported by the suspended ceiling or its supporting members, lighting fixtures, mechanical piping, or air-conditioning ducts.

P. Work with extreme care near existing ducts, conduits, cables and other utilities to avoid damaging them.

Q. For acoustically treated areas, provide the following:

1. Flexible conduit at the entries, exits, and outlets.
2. Sealing fittings with compound at the entries and exits.
3. Supports of rubber-in-shear ceiling hangers.
4. Expansion fittings at isolating slab joints.
5. Rubber gasketed device plates.
6. Back plaster recessed outlets.
7. Freestanding equipment with vibration dampers.

R. Galvanized Rigid steel conduit:

1. Paint male threads of field threaded conduit with graphite base pipe compound.

    a. Where located in slabs, the maximum outside diameter of the conduit shall be less than 1/3 the slab thickness. When locating in the slab, place conduits in a manner so as to interfere with the placement of reinforcing bars or cause damage to structural members or structural support.
    b. Where located in concrete fill, the conduit shall have a minimum of 1 in. cover.
    c. Where located under the building, conduit shall be concrete encased.

S. Intermediate metal conduit:

1. Paint male threads of field threaded conduit with graphite base pipe compounds.
2. Where located in slabs, the maximum outside diameter of the conduit shall be less than 1/3 the slab thickness. When locating conduit in the slab, place conduits in a manner so as not to interfere with the placement of reinforcing rods or cause damage to structural members of structural support.
3. Where located in concrete fill, the conduit shall have a minimum of 1 in. cover.
4. In terrazzo floor finish, intermediate metal conduit is not permitted.
5. Where located under the building, conduit shall be concrete encased.

T. Electric metallic tubing (EMT):

1. EMT is permitted to be used with the following limitations: for branch circuits only, and in dry locations (hung ceilings, hollow block walls and furred spaces).

U. Flexible steel conduit:

1. Flexible steel conduit "Greenfield", shall be used for the following applications: for short connections where rigid conduit or tubing is impracticable, from outlet box to recessed lighting fixture with minimum length of 4 ft. and a maximum length of 6 ft.
2. Connect the ground conductor to the enclosure or raceway at each end.

V. Aluminum conduit:

1. Shall not be used in or on concrete or masonry and shall not be used in wet locations.
2. Where routed through concrete and masonry walls and floors, conduit shall be painted with asphaltum.
3. Maintain clearance between aluminum conduits and surfaces for the following conditions: in moist locations, in interior spaces below exterior finished grade, and boiler rooms.
4. When connecting to steel surfaces, maintain galvanized-to-aluminum contact, or paint with asphalt base paint.

W. Surface metal raceways shall be used only where shown on the drawings or as directed by the Architect.

X. Provide expansion-deflection fittings at expansion joints and on length of runs in accordance with manufacturer's recommendations. Expansion-deflection fittings shall be of size as required complete with bonding jumper.

Y. For Wet, Damp, or Moist Locations:

1. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, much as refrigerated spaces, air conditioned spaces, or similar spaces.

3.4 SLEEVES

A. Sleeves shall be provided in accordance with the following guidelines:

1. Set required sleeves and inserts in place during progress of construction to avoid cutting of completed work.
2. Provide sleeves for raceway passing through floors and foundations. Determine exact location of sleeves in field to avoid interference with structural members or equipment of all trades.
3. Install sleeves rigidly so that proper position and alignment will be maintained during construction and pouring of concrete.

3.5 FIRE STOPS

A. Where wiring, conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, or floors, install an approved fire-stop that provides an effective barrier against the spread of fire, smoke and gases. Fire-stop material shall be packed tight and shall completely fill clearances between raceways and openings.

B. Floor, exterior wall, and roof seals shall also be made watertight.

3.6 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

3.7 FIELD QUALITY CONTROL

A. Contractor shall perform continuity tests by testing the resistance of all feeder conduits from the service to the point of their final distribution using 1 conductor return. The maximum resistance shall be 25 ohms.

END OF SECTION 260533

SECTION 260534 - ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.

B. This section is a Division 26 Basic Electrical Material and Methods section and is a part of each Division 26 section making reference to electrical wiring boxes and fittings specified herein.

1.2 DESCRIPTION OF WORK

A. Drawings are diagrammatic. All bends, boxes, fittings, couplings are not necessarily shown. Supply as necessary to comply with the National Electric Code.

B. Types of electrical boxes and fittings specified in this section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. Bushings.
5. Locknuts.
6. Knockout closures.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five years.

B. Installer's Qualifications: Firms with at least five years of successful installation experience on projects utilizing electrical boxes and fittings similar to those required for this project.

C. Local Code and NEC Compliance: Comply with local code and NEC as applicable to construction and installation of electrical wiring boxes and fittings.

D. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL-listed and labeled.

E. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and PUB 250 pertaining to outlet and device boxes, covers and box supports.

F. Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps."

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data on electrical boxes and fittings.

B. Shop Drawings: Submit layout drawings of electrical floor, junction and pull boxes showing accurately scaled box layouts and their spatial relationship to associated equipment.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

A. Outlet boxes for concealed work shall be galvanized steel, 4 in. square or octagon (except as otherwise required by construction, devices or wiring) and as follows:
1. Above ceiling: 1-1/2 in. deep.
2. In ceiling or slab: 3 in. deep.
3. In wall for fixtures: 2-3/4 in. deep.
4. In wall for receptacles and switches: 1-1/2 in. deep.
5. With raised covers and fixtures studs where required.
6. Through-the-wall type are not permitted.

B. Outlet boxes for exposed work shall be galvanized cast iron or aluminum with threaded hubs. Except as otherwise required by construction, devices or wiring the outlet boxes shall be in 4 in. round x 2 in. deep for mounting on ceilings and 4 in. square x 2 in. deep for mounting on walls.

C. Outlet boxes without fixture or device, shall have blank cover.

D. Extension rings shall be provided as required to suit various conditions.

E. Grounding screw and cable wiring connector shall be provided as required by wiring method.

F. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides.

G. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

H. Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

I. Outlet boxes located in damp locations shall be weatherproof corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.

2.2 JUNCTION AND PULL BOXES

A. Junction and pull boxes shall be made of galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers. Pull boxes installed in finished spaces must be flush mounted cabinets provided with trim, hinged door and flush latch and lock to match flush mounted panelboard trim.

B. Provide junction and/or pull boxes as noted or as required. All junction and pull boxes shall be accessible.

C. Junction and pull boxes located outdoors and in damp locations shall be galvanized cast iron with threaded hubs and gaskets.

D. Junction or pull box to be mounted flush with grade shall be polymer composite raintight with screw cover lids. Box dimensions shall be 30”W x 48”L x 36”D. Covers shall be polymer composite suitable for pedestrian traffic secured to box with stainless steel screws. Box to be furnished with continuous neoprene gasket to seal cover. Conduit entry shall be on side of box with bell ends.

E. Provide barriers in junction boxes or pull boxes between:

1. 277/480 volt wiring energized from separate services.
2. 120/208 volt and 277/480 volt wiring.
3. Emergency and normal wiring.

2.3 FLOOR BOXES

A. Floor boxes shall be galvanized cast iron watertight, corrosion-resistant with brass covers and flanges. They shall be suitable for the conduits and the devices noted. Floor Boxes shall be similar to Hubbell Dualevel Series.

2.4 BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS

A. Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings in accordance with manufacturer’s written instructions, applicable requirements of local codes, NEC and NECA’s “Standard of Installation,” and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide raintight “in use” outlets for interior and exterior locations exposed to weather or moisture.

D. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

E. Boxes separated by less than 24 inches shall be provided with firestop putty pads on the backside of all boxes exceeding 16 sq. inches in area. Provide Firestop putty pads on the back side for all outlet boxes within 24 inches of each other, in opposite sides, and at same elevation, in the same wall. Provide Firestop putty pads on the back side for all boxes in a wall or ceiling where the aggregate surface area of the outlet boxes exceeds 100 sq. inches per 100 sf of surface of wall or ceiling area. Firestop putty pads shall be Hilti CP617XI (9” x 9”) for each box 16 sq inches or less.

F. Position recessed outlet boxes accurately to allow for surface finish thickness.

G. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.

H. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embedded electrical boxes in concrete or masonry.

I. Provide electrical connections for installed boxes.

J. Exterior junction or pull boxes shall be mounted flush with grade, unless noted otherwise or indicated to be above ground on the drawings. Boxes shall be surrounded on all sides with 6 inches minimum of concrete. Top of concrete shall flush with grade. Seal all conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.

K. Tap and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.

L. Subsequent to installation of boxes, protect boxes from construction debris and damage.

M. Set boxes square and true with the building finish. Boxes shall be secured to the building structure by adjustable strap irons.

N. Verify outlet locations in finished spaces with Architectural Drawings of interior details and finishes. Take caution in locating outlet to allow for overhead pipes, ducts, and variations in arrangement, thickness in finish, window trim and other Architectural Construction Details.

O. Correct any inaccuracy in locating outlets without additional expense to the Owner. Refer to Architect any condition that would place an outlet box in an unsuitable location, such as a molding, break glass in wall finish, or behind radiator.

P. Mount outlet boxes for similar equipment at uniform height within same or similar areas. Where mounting height or location of outlets is not shown or specified, mount outlet as best suited for equipment connected thereto, or as directed.

Q. Close all unused openings in outlet boxes with knockout closers manufactured for this purpose. Provide blank plates on outlet boxes in which no device is installed or device installed does not provide a suitable cover.

R. Provide barriers between switches connected to different phases for voltages exceeding 150 volts to ground.

S. Outlet boxes for fixtures recessed in hung ceilings, shall be accessible through the opening created by the removal of the fixture.

T. Securely fasten exposed outlet boxes by attaching to permanent inserts or lead anchors with machine screws. Adequately support all boxes during construction to prevent movement.

U. Boxes for concealed work shall be pressed steel galvanized and shall conform to UL's "Standard for Outlet Boxes and Fittings." Outlet boxes shall be provided with a galvanized steel cover or extension ring depth as required.

V. All ceiling fixture outlet boxes, except as noted, shall be 4" octagonal and 1-5/8" deep and with 3/8" fixture stud. Where cast in slab, boxes shall be open back concrete type.

W. Wall bracket outlets shall be 4" square and 1-5/8" deep with cover having 2-7/8" round openings and except for lampholders shall be furnished with fixture stud.

X. Junction outlets shall be the same as bracket outlets but without stud, furnished with covers to suit each condition and as directed. Where number of conductors exceed capacity of standard box, provide special size box.

Y. All outlet boxes for concealed convenience receptacles or local switches shall be 4" square and 1-5/8" deep with regular deep switch extension cover, except where installed on columns they shall be of sufficient depth so that conduits may be installed into these boxes in back of fireproofing. Outlet boxes for gang receptacles and switches shall suit space conditions.

Z. Boxes for use with surface mounted raceways shall be of the same construction and manufacture as the raceway.

AA. Boxes shall be of the cast type for switches and receptacles when installed on the exterior of the project. Such boxes shall be aluminum or malleable iron of the threaded hub type, with covers without projecting edges or corners and with openings suitable for the devices to be contained therein. Outlet boxes and covers shall be galvanized or anodized and shall be gasketed.

BB. Except where special outlets are required, wall outlets for signaling systems shall be 4" square with single gang raised cover and bushed plate.

CC. Panel, junction and pull boxes:

1. Panel, junction and pull boxes shall be located clear of other trades equipment, accessible, supported from the building structure, and independent of the conduits.
2. Conceal junction and pull boxes in finished spaces.
3. Coordinate size of motor terminal boxes with motor branch circuit conduit and wiring.

3.2 GROUNDING

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION 260534

SECTION 260548 - VIBRATION ISOLATION SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install vibration control devices, materials, and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.

1.2 MATERIAL AND EQUIPMENT

A. All vibration isolation mounts shall be supplied by one of the approved manufacturers stated in the PRODUCTS Section of this specification. Substitutions of equal equipment beyond the alternatives listed will be permitted only with the written permission of the Architect. Accompany each request for acceptance of substitute equipment with manufacturer's certified data proving the equivalence of the proposed substitute in quality and performance. The Architect shall be the final judge of the validity of the data submitted.

B. Unless otherwise specified, supply only new equipment, parts, and materials.

1.3 SUBMITTALS

A. Refer to related sections elsewhere for procedural instructions for submittals.

B. The shop drawing submittal for isolated electrical equipment shall include submittal information for the isolation mounts. Information supplied shall be as follows:

1. A complete description of products to be supplied including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:
   a. The equipment identification mark.
   b. The isolator type.
   c. The actual load.

C. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the Contractor.

1.4 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes and proper loading to meet the specified requirements.

C. Supply and install any incidental materials needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim for additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

E. Should any electrical equipment cause excessive noise or vibration, the Contractor shall be responsible for remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

F. Upon completion of the work, the Architect or Architect's representative shall inspect the installation and shall inform the installing contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION MOUNT TYPES

A. Type DNP (Double Neoprene Pad):

1. Neoprene pad isolators shall be formed by two layers of ¼" to 5/16" thick ribbed or waffled neoprene, separated by a stainless steel or aluminum plate. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type DNP isolators shall be formed from one of the following products or approved equal:

Type NR	Amber/Booth
Type Korpad	Korfund Dynamics
Type WSW	Mason Industries
Type NPS	Kinetics Noise Control
Series Shear Flex	Vibration Mountings & Control

B. Type HN (Hanger Neoprene):

1. Vibration isolation hangers shall consist of a neoprene-in-shear or glass fiber element contained in a steel housing. A neoprene neck bushing (or other element) shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30° arc before contacting the hanger housing.
2. Type HN isolators shall be one of the following products or approved equal:

Type BRDA	Amber/Booth
Type H	Korfund Dynamics
Type HD	Mason Industries
Type RH or FH	Kinetics Noise Control
Type RHD or RFD	Vibration Mountings & Control

2.2 FLEXIBLE ELECTRICAL CONNECTIONS

A. Type A:

1. Flexible Electrical Connection Type A shall be a prefabricated unit incorporating a flexible and watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wireway, and end hubs with tapered electrical threads to fit standard threaded rigid metal conduit.
2. Flexible Electrical Connection Type A shall be Crouse-Hinds (Syracuse, NY) “XD Expansion/Deflection Coupling,” Spring City Electrical Mfg. Co. (Spring City, PA) “Type DF Expansion and Deflection Fitting,,” or approved equal.

B. Type B:

1. Flexible Electrical Connection Type B shall be field fabricated using a minimum 2 (two) foot length of flexible conduit or cable.

C. Type C:

1. Flexible Electrical Connection Type C shall be field fabricated using a minimum 4 (four) foot length of flexible conduit or cable.

PART 3 - EXECUTION

3.1 APPLICATION

A. Mechanical Equipment:

1. Electrical connections to vibration isolated mechanical equipment shall be made using flexible electrical connections Type A or Type C.

3.2 INSTALLATION

A. General:

1. In all cases, isolated electrical equipment shall be positioned so that it is free standing and does not come in rigid contact with the building structure or other systems.

B. Isolation Mounts:

1. All mounts shall be aligned squarely above or below mounting points for the supported equipment.
2. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plate shall rest entirely on the pad.
3. Hanger rods for vibration isolated supports shall be connected to structural beams or joists, not to the floor slab between beams and joists. Provide suitable intermediate support members as necessary.
4. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.

C. Flexible Electrical Connections:

1. Type C connections shall be installed in a grossly slack “U” shape or a 360 loop.
2. Rigid conduit on the isolated-equipment side of the flexible connection, and the flexible connection itself, shall not be tied to the building construction or other rigid structures.

END OF SECTION 260548

SECTION 260549 - SEISMIC DESIGN

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Seismic restraints and/or bracing shall be provided for selected electrical equipment and wiring methods as described hereinafter. These seismic design requirements are complementary to the requirements specified elsewhere for the fastening and support of electrical work. Nothing on the drawings or elsewhere in these specifications shall be interpreted as a reason to waive any of the requirements of this Seismic Design section.

B. This project is located in Seismic zone 2.

C. Provide seismic support for the following items:

Emergency panelboards
All lighting fixtures and exit signs
Emergency battery packs
Fire alarm/detection systems
In hospitals, nurse call and telephone systems
Raceways associated with emergency lighting/power, fire alarm/detection system, and hospital communication systems
Dry type transformers
Raceways 2½" and larger suspended on individual hangers longer than12 inches, and all raceways on trapezes.

D. All seismic restraint and isolation devices, braces, and supports shall be capable of accepting without failure forces produced by seismic acceleration (expressed in multiples of the acceleration of gravity "G") based on the level grade of the attachment of the equipment support system. For design purposes, the following acceleration levels shall be used.

DESIGN LEVEL OF ACCELERATION AT EQUIPMENT CENTER OF GRAVITY			
ELEVATION ABOVE GRADE	RIGIDLY FLOOR OR WALL MOUNTED EQUIPMENT	RESILIENTLY MOUNTED AND/OR SUPPORTED FROM CEILING OR STRUCTURE ABOVE	LIFE SAFETY EQUIPMENT (FIRE ALARM, HOSPITAL COMMUNICATIONS, EMERGENCY
SEISMIC ZONE 2 A_v = 0.10 TO 0.19			
BELOW GRADE UP TO 20 FEET ABOVE GRADE	0.125 "G"	0.500 "G"	1.000 "G"
21 FEET – 300 FEET	0.500 "G'	0.750 "G"	
301 FEET – 600 FT.	0.750 "G"	1.000 "G"	

1.3 OEM EQUIPMENT ISOLATION PACKAGES

A. Internal and/or External Systems

1. Substitution of internally or externally isolated or restrained equipment instead of the isolation and restraints specified in this section is acceptable provided all requirements of this section are met. The equipment manufacturer shall provide a letter of guarantee from their Engineering Department stamped and certifying that the seismic restraints are in full compliance with these specifications. Letters from field offices and representatives are unacceptable.
2. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the equipment manufacturer in the event of non-compliance with the preceding.
3. In the event that the equipment is internally isolated and restrained, the entire unit assembly must be seismically attached to the structure.

1.4 SUBMITTALS

A. Seismic Certification and Analysis

1. Provide seismic restraint calculations certifying that all seismic restraint devices are capable of accepting, without failure, the “G” forces shown in the table above. Calculations shall be provided for all connections of the equipment to the structure. All performance of products (such as strut, cable, anchors, clips, etc.) associated with restraints must be supported by the manufacturer’s data sheets or certified calculations. For roof mounted equipment, both the seismic acceleration and wind loads shall be calculated. The highest load shall be used for the design of the restraints and isolators.
2. Calculations to support seismic restraint designs must be stamped by a registered professional engineer with at least five years of seismic design experience.
3. Analysis must indicate calculated dead loads, derived loads, and materials used for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or weld length.

1.5 RELATED WORK

A. Housekeeping Steel

1. Where steel sills are called for under a piece of electrical equipment, attachment shall be designed and certified according to this section by the seismic/isolation supplier.
2. Steel sills shall be sized to accommodate a minimum of six inches of clearance all around the equipment and its mounting package. In addition, ¾” clearance shall be provided between the electrical equipment and the steel sills so that the space may be kept clear of debris that would inhibit the isolation.

B. Supplementary Support Steel

1. Structural support and connections for all electrical equipment, including roof mounted equipment, specified in other sections shall comply with the seismic requirements of this section.

C. Design Responsibilities

1. Include the following in the responsibility of the seismic equipment supplier:

a. Determine guidelines for vibration isolation and restraint size and location.
b. Provide equipment vibration isolation and seismic restraints as required.
c. Guarantee specified isolation system deflections.
d. Provide installation instructions, drawings, and field supervision to insure proper installation and performance of systems.
e. Certify correctness of installation upon completion.

1.6 QUALITY ASSURANCE

A. Installation of electrical equipment shall, as a minimum, be installed in accordance with the latest applicable edition of the New York State Building Code.

B. Listing and Labeling: Provide products that are Underwriters Laboratories listed and labeled for their applications and installation conditions and for the environments in which installed.

1. The Terms “Listed” and “Labeled”: As defined in the “National Electrical Code”, Article 100.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available manufactures: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. AVNEC, Inc. of Floral Park, NY
2. Mason Industries, Inc. of Hauppage, NY
3. Vibration Mounting and Control of Butler, NJ
4. Consolidated Kinetics of Columbus, OH

B. Attachments

1. Hardware and devices such as beam clamps, anchor bolts, cables, and cast-in-place plates must be by this section’s supplier to ensure seismic compliance and certification. Alternate anchor bolts may be provided so long as the sizing and dimensions on the seismic submittals are followed:

2.2 SEISMIC RESTRAINTS AND VIBRATION ISOLATORS

A. General

1. All isolation and seismic restraint devices shall be capable of accepting, without failure, the “G” forces as determined by the seismic certification and calculations described above.
2. Corrosion protection for both indoor and outdoor applications shall be as follows:

a. Springs – Cadmium plated, zinc electroplated, or powder coat.
b. Hardware – cadmium plated
c. All other metal parts – hot spray or hot dipped galvanized.

3. All seismic restraint devices:
   a. Shall maintain the equipment in a captive position and not short circuit isolation devices during normal operating conditions.
   b. Shall have provisions for boiling and/or welding to the structure.

B. Seismic Restraint Types

1. Restraints for suspended systems
   a. Isolated systems and, where required elsewhere by this specification, lighting fixtures – braced with multiple steel cable with approved fastening devices to equipment and structure.
   b. Non-isolated systems – braced with structural steel strut with approved fastening devices to equipment and structure.

2. Restraints for systems rigidly connected to walls or floor or ceiling slabs.

   a. Rigid attachment to structure using wedge type expansion anchors for bolting and steel plates, either cast-in or anchored with wedge type expansion bolts, for welding. Power shots are not acceptable. Concrete anchor bolt spacing shall be in accordance with ICBO National Standards for seismic anchorage.

C. Vibration Isolator Types

1. For Dry Type Transformers –

   a. Double deflection neoprene isolators encased in ductile iron or steel casing.

2. For Conduit Risers – Resilient Conduit Anchors and Guides

   a. One inch of six pound density Fiberglass packed around the conduit.

PART 3 – EXECUTION

3.1 APPLICATION

A. Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all submittal data.

B. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.

3.2 INSTALLATION

A. Equipment shall be restrained as indicated in the table at the end of this specification.

B. Additional Requirements

1. All bases shall be placed in position and supported temporarily by blocks or shims prior to the installation of the equipment, isolators, and restraints.
2. Spring isolators shall be installed after all equipment is installed without changing equipment elevations.
3. After the entire installation is complete and under full operation load, the spring isolators shall be adjusted so that the load is transferred from the blocks to the isolators.
4. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment's movement shall be free in all directions.
5. All electrical connections to isolated equipment such as transformers shall be in flexible conduit.
6. Use wedge type expansion bolts to bolt the base to the structure.

3.3 SEISMIC RESTRAINTS

A. Installation

1. All equipment specified to receive seismic support shall be restrained per the table at the end of this section.
2. All floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted, or welded to the structure to comply with the required acceleration. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers (restraints) do not preclude the need for snubbers. All equipment must be positively attached to the structure.
3. Lighting fixtures shall be seismically restrained in accordance with the following:

    a. All lighting fixtures and exit signs throughout the building shall be provided with seismic restraints.
    b. Lighting fixtures recessed into suspended ceilings or surface mounted on the underside of suspended ceilings shall be provided with at least two supports, each independently connected to the slab above by means of cable type restraints as described hereinbefore for suspended systems, each restraint capable of supporting 100% of the fixture weight.
    c. Pendant mounted lighting fixtures shall be supported from the slab above utilizing approved fixture hangers designed to permit a swing of at least 20" in any direction without damage to the fixture, hangers, or structure. Each support shall be capable of supporting 100% of the fixture weight. If there are obstructions preventing the free swing, provide additional support bracing to restrain 50% of the fixture weight. Pendant mounted fixtures below suspended ceilings shall be supported at the ceiling level and shall have cable to the slab above.
    d. Lighting fixtures surface mounted directly to ceiling slabs, walls or structural elements shall be rigidly attached using restraints specified hereinbefore for rigidly connected ceiling slabs or walls.

4. All horizontally suspended conduit systems shall use restraints for non-isolated suspended systems. Spacing of seismic bracing shall be according to table below. All bus ducts and cable trays passing through floors shall be bolted at each floor level or secured above and below each floor with riser clamps. This restraint shall be in addition to the spring type hangers specified.

SEISMIC BRACING TABLE		
EQUIPMENT	ON CENTER SPACING	
	TRANS-	LONGITU-
CONDUIT	40 FEET	80 FEET

5. For all seismically supported trapeze supported conduit, the individual conduits shall be transversely and vertically restrained to the trapeze support at the designated restraint locations. Restrain at least every third trapeze hanger transversely and every fifth one longitudinally as well as the trapeze on both sides of every change of direction.
6. For overhead supported equipment, overstress of the building structure must not occur. Bracing may occur from:

   a. Flanges of structural steel beams.
   b. Upper truss chords in bar joists.
   c. Cast in place or drilled and shielded inserts in concrete structures.

7. For dry type transformers suspended from the slab above, use isolators with 0.20" deflection and seismic restraints for isolated, suspended equipment.
8. Where conduits pass through cored or sleeved holes, the holes shall be a maximum of 2" larger than the conduit O.D. Pack the space with fireproofing material. No additional horizontal seismic bracing is required at these locations.
9. All non-isolated floor or wall mounted equipment such as panelboards, etc. which require restraint shall use restraint for rigid attachment. For floor mounted transformers up to and including 300 kva, use isolators with a 0.30" deflection and rigid attachment seismic restraints. Where base anchoring of equipment is insufficient to resist seismic forces, additional restraints for suspended, non-isolated equipment shall be located above the unit's center of gravity to suitably resist "G" forces specified.

3.4 INSPECTION

A. Upon completion of installation of all vibration isolation and seismic restraint devices, a certification report prepared by the manufacturer shall be submitted in writing to the architect/engineer indicating that all systems are installed properly and in compliance with the specifications. The report shall identify those areas that require corrective measures or certify that none exist. Any field coordination type changes to the originally submitted seismic restraint designs must be clearly defined and detailed in this report.

END OF SECTION 260549

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this Section:

1. “Electrical Requirements.”

1.2 SUMMARY

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Identification labeling for raceways, cables, and conductors.
2. Operational instruction signs.
3. Warning and caution signs.
4. Equipment labels and signs.

B. Related Sections: The following Sections contain requirements that relate to this Section;

1. Division 9 Section “Painting” for related identification requirements.
2. Division 26 Section “Wires and Cables” for requirements for color coding of conductors for phase identification.

C. Refer to other Division 26 Sections for additional specific electrical identification associated with specific items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Schedule of identification nomenclature to be used for identification signs and labels.

D. Samples of engraved, plastic laminate to be used on switchgear, switchboards, disconnect switches and panelboards.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

B. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, “Scheme for the identification of Piping Systems,” with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

A. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mil thick by 1 inch to 2 inches in width.

B. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wrap around, cable/conductor markers with preprinted numbers and letters.

C. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for sign up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in black letters on white face for normal power and red letters on white face for emergency power. Plastic laminate shall be punched for mechanical fasteners.

D. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

F. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer’s written instructions and requirements of local codes and the NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2 CONDUIT IDENTIFICATION

A. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels at concealed boxes.

B. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be painted with colors indicated below. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:

1. Fire Alarm Systems: Red.
2. Fire Suppression Supervisory and Control System: Red and Yellow.
3. Mechanical and Electrical Supervisory System: Green and Blue.
4. Telephone System: Green and Yellow.
5. Tag or label conductors as follows:
   a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and intent.
   b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure label each conductor or cable. Provide label on each box indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
   c. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facilities' electrical installations.

C. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

D. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

E. Use conductors with color factory-applied the entire length of the conductors except as follows:

1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG:
   a. Apply colored, pressure-sensitive plastic tap in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

2. All grounded conductors No. 6 AWG and smaller shall be a factory applied color across the entire length of conductors.

F. Power Circuit Identification:

1. Securely fasten wrap-around marker bands to cables, feeders, and power circuits in pull boxes, junction boxes, and switchgear rooms.

G. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, or instruction signs where required by NEC where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.

H. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit for electrical equipment including central or master unit of each electrical system. This includes communication/signal/alarm system, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 3/8-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), black lettering in white field for normal power and red lettering on white field for emergency power. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Contactors.
   d. Remote-controlled switches.
   e. Control devices.
   f. Transformers.

I. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification (including room numbers) of items controlled by each individual breaker.

J. Arc Flash Warning Signs: Provide arc flash warning signs at all panelboards, control panels, starters, ches, etc., that may be subject to inspection or repair. Warning signs shall be white letters on a red background with informative text in black on a white background. Signs shall be permanently affixed directly to the equipment in a readily visible location or located adjacent to the equipment with a smaller warning label on the equipment that directs maintenance personnel to the more informative sign. Warning sign data shall be appropriate and specific to each piece of equipment or device and shall identify flash hazard category, incident energy, VAC shock hazard, flash protection boundary, limited approach boundary, restricted approach boundary, restricted approach boundary, and prohibited approach boundary. Warning sign shall also indicate all recommended protective equipment. Calculations supporting the data on

each warning sign shall be completed by a licensed professional engineer hired by the Contractor and presented to the owner in book form for future reference. Arch flash warning signs shall be in accordance to the most stringent of NFPA 70E, NFPA 70, and OSHA.

END OF SECTION 260553

SECTION 23 09 33 – ARCHITECTURAL LIGHTING CONTRLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work of this section.

B. Division-26 Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Provide and install dimming lighting controls as shown on drawings and as described in these Specifications.

B. Provide interface module for each dimming lighting control specified in this Section with the Building Lighting Control System specified in Section 26 09 43.

C. Provide all lighting controls as shown, completely wired, operative and securely attached to supports.

D. Where a catalog number and a narrative or pictorial description are provided, the written description shall take precedence and prevail.

E. General Contractor shall provide electrical subcontractor with entire lighting control specification (including illustrations and sketches); electrical subcontractor shall provide each specified manufacturer with complete information about the lighting controls they will supply.

F. Type of lighting controls shall be as indicated alphanumerically and as specified.

G. Lighting control details shown may be modified by the manufacturer provided all of the following conditions have been met:

1. Lighting control performance is equal or improved;
2. Performance of fixtures connected to lighting control is equal or improved;
3. Structural, mechanical, electrical, safety, and maintenance characteristics are equal or improved.
4. Cost to the Owner is reduced or equal.
5. Modifications have been reviewed by the Architect and have been approved by the Architect in writing.

1.3 SUBMITTALS

A. For standard catalog items with no modifications, submit catalog cut sheets prepared by the manufacturer. Cut sheets to clearly show all elements to be supplied and all corresponding product data (including dimming range, lamp and ballast compatibility, voltage, faceplate design and finish, accessories, options, all dimensions and any miscellaneous items detailed in the written description of the specification). If a cut sheet shows more than one (1) product, all non-applicable information shall be crossed out.

B. For standard cataloged lighting controls submit a complete list of materials, including catalog or part numbers, load schedule, address description, function and location.

C. For custom lighting controls submit a reproducible shop drawing prepared by the manufacturer and drawn to scale. Shop drawing to include the name and location of the project. Indicate all corresponding product data including all elements to be supplied, dimming range, lamp and ballast compatibility, voltage, faceplate design and finish, accessories, options, all dimensions and any miscellaneous items detailed in the written description of the specification.

D. For all submittals under paragraphs A through C above, manufacturer shall provide submittals within two weeks of receipt of order. All submittals shall have project name and lighting control type clearly shown.

E. Lighting control cuts and shop drawings shall be submitted in quantities and formats as described in the General Conditions Section of these Specifications.

F. The Engineer and Architect shall make the final determination as to whether or not the submittal contains sufficient information and reserves the right to request a shop drawing if the lighting control cut is insufficient.

1.4 SUBSTITUTIONS

A. Bidders' attention is called to the following procedure to be followed in submitting alternate lighting control manufacturers to those specified:

1. Request for approval shall be accompanied by working lighting control samples (with appropriate mechanical and electrical data, list of materials and finishes and unit cost to the Owner) of both the specified brand and the proposed substitutes as required to make complete comparison and evaluation. These samples shall be in addition to those required by these Specifications. The above data shall be delivered separately to the Architect and Engineer. The samples may be required to be furnished and installed, at the bidder's expense, at a location selected by the Architect. In addition, the bidder shall furnish the Architect and the Engineer with the name and location of at least one completed project where each proposed substitute has been in operation for a period of at least one year (12) months, as well as the names and addresses of the Owner, the Architect and the Lighting Designer.

1.5 QUALITY ASSURANCE

A. All lighting controls and assembled components shall be new, of good quality, and be approved by and bear the label of UL or other approved testing agency (i.e. CSA, ETL) unless otherwise specified in writing.

B. All lighting controls shall meet all required local, state and/or national building, electrical and energy codes and regulations.

1.6 CUSTOMER SUPPORT SERVICES

A. Commissioning: The manufacturer shall supply factory-trained representatives to commission the lighting control system. They shall verify that the contractor has properly installed and interconnected all supplied components. They shall start up all equipment and demonstrate that it meets the requirements of this specification.

B. Training: As part of the commissioning procedures, the manufacturer shall train the owner’s representatives in the operation of the system.

C. Technical Support: The manufacturer shall supply telephone support at no additional cost to the owner for the duration of the warranty period.

D. Replacement components: The manufacturer shall be able to ship replacement parts within 24 hours for any component that fails during the warranty period.

E. Extended Service Coverage: Maintenance agreements shall be available from the manufacturer to provide service for the system both during and after the warranty period.

1.7 WARRANTIES

A. All lighting controls, including parts and workmanship, shall have a warranty of a minimum of one year after the acceptance of the project by the Owner. Any lighting controls found to be defective during the warranty period will be repaired or replaced at no cost to the Owner.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver lighting control equipment and components in factory-fabricated type containers or wrappings, which properly protect equipment from damage.

B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2 - PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

A. Acceptable manufacturer: Lutron, etc. or approved equal.

B. Manufacturer's Qualifications: The basis of design is Lutron Grafic Eye 4000 series. Similar systems from other manufacturers that meet the functional and performance requirements listed herein will be considered. A detailed line-by-line compliance comparison shall be submitted for the Engineer's review of any alternate system. It is the sole responsibility of the Electrical contractor to ensure that all equipment meets the specifications.

C. Lighting controls shall be fully compatible with all specified fixtures, lamps, transformers and ballasts.

D. Unless otherwise specified, all lighting controls shall be by the same manufacturer.

1. The listing of a manufacture as "acceptable" does not imply automatic approval. It is the responsibility of the Contractor to ensure that any price quotations received and submittals are made for devices that meet or exceed these Specifications.

E. Lighting controls shall operate at the voltage shown in the LIGHTING FIXTURE SCHEDULE and confirmed on the electrical drawings.

F. Dimmers and preset dimming lighting controls shall operate the following sources/load types with a smooth continuous Square Law dimming curve. Dimmers shall also be capable of operating these sources on a non-dim basis. Dimmers shall be electronically assigned to the appropriate load type/dimming curve and can be reassigned at any time. Universal-type dimmers that do not adjust the dimming curve shall not be acceptable.

1. Incandescent, Tungsten and Magnetic Low Voltage Transformer
   a. Dimmer shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low voltage transformers.
   b. Dimmer shall not cause a magnetic low voltage transformer to operate above the transformer's rated operating current and temperature.
   c. Dimmer shall contain circuitry to control dioded lamps.
2. Electronic Low Voltage Transformer
   a. No flicker or interaction shall occur at any point in the dimming range.
   b. For integral dimming, an interface shall be required.
3. Electronic Fluorescent Dimming Ballast
   a. Dimmer shall be rated to control ballasts for T-12, T-12 high output, T-8, and T-5 lamps as well as T-4 compact lamps. All lamps on the same circuit must have the same current rating (i.e., T-8), but may be different lengths (i.e., 3' and 4'). Ballasts for fluorescent fixtures must be manufactured by Lutron. The dimming performance shall be as specified in the Lighting Fixture Specifications.
4. Neon and Cold-Cathode
   a. Dimmer shall provide the ability to dim lamps down to 10% of full light output when used with normal (low) power factor transformers. Transformers shall be sized per table developed by dimming system manufacturer.
5. Non-Dim/Switched Loads
   a. Non-dim shall be rated to 16A of resistive, tungsten, induction, or capacitive loads. Non-dim shall incorporate an air gap relay to open circuit when load is off.

G. Dimming Panels

1. Panel shall be wall or floor mounted NEMA grade, constructed of sheet steel plates not less than #16 U.S gauge. Contractor shall reinforce wall as required for wall-mounted panels.
2. Panel shall be completely pre-wired by the manufacturer. The contractor shall be required to provide input feed wiring, load wiring, and control wiring. No other wiring or assembly by the contractor shall be permitted.
3. Unless otherwise indicated, panels shall contain branch circuit protection for each dimming module. Branch circuit breakers shall have the following performance characteristics:
   a. Be U.L listed under U.L 489 as molded case circuit breaker for use on lighting circuits.
   b. Contain a visual trip indicator and shall be rated at 10,000 AIC (120V) or 14,000 AIC (277V), unless otherwise noted.
   c. Be thermal-magnetic in construction for both overload and dead short protection. The use of fully magnetic breakers shall not be acceptable, even when used in conjunction with individual dimmer thermal cutouts.
   d. Be switched duty (SWD) rated so that the loads can be switched off via the breaker.
4. Panel shall be shipped with each dimmer in a BYPASS position via a jumper bar inserted between the input and load terminals. These jumpers shall carry the complete load current and shall be reusable at any time.

5. Panels shall be cooled via free-convection, unaided by fans, and capable of continuous operation to all of these Specifications within an ambient temperature range of 0°C (32°F) to 40°C (104°F).
6. Panel shall provide capability to electronically assign each circuit any zone in the dimming system. Panels using mechanical switches, rewiring, or EPROMS shall not be acceptable.
7. Multiple panels shall be capable of operating in one system, up to a maximum of 32 panels and 768 dimmers. Panels shall have the ability to control individual circuits without controls.
8. For panels fed with normal/emergency feeder, panel shall include electronics to bring all circuits to full on condition upon loss of normal power and subsequent presence of emergency power. Electronics shall switch both the intensity signal and the on/off signal of each dimmer connected to an emergency circuit between the local and a full-on constant drive supply. This type of emergency may be used with either a normal/emergency generator or a constant hot secondary utility feed where the emergency transfer occurs on the line side (upstream) of the dimming panel and requires only a single normal/emergency feeder.
9. Panels shall have the following additional characteristics:
    a. Be designed to prevent any foreign objects from coming into contact with any part of the panel which would be at an elevated temperature, such as the dimmer extrusions or heat fins.
    b. Be designed to provide airflow across the heat sink areas and through the dimmer chassis. Panel sections which provide airflow only across heat sinks shall not be mounted one above another in order to allow for adequate heat dissipation.

H. Dimming Modules

1. One type of modular dimming card shall be used for all sources. Systems requiring different types of modules or modular dimming cards shall not be acceptable.
2. A positive air gap relay shall be employed with each dimmer to ensure that the load circuits are open when the “off” function is selected at a control station. These relays need not be integral to the dimming module but must be integral to the dimming panel. Lighting control manufacturer shall provide necessary control interface(s) as part of the control system.
3. All dimmers shall be voltage regulated so that a nominal change in the voltage shall not cause a perceptible change in output voltage.
4. The silicon thyristors used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6000VA , 3000A (equivalent to near lightning strike) as specified by ANSI/IEEE std. C62.41. Upon request, the manufacturer shall provide a means to demonstrate conformance to this specification using the appropriate surge-generation equipment.
5. Under full-load conditions in a 40°C environment, all silicon thyristors shall operate at minimum 20°C safely margin below the component temperature rating.
6. Filtering shall be provided in each circuit so that the current rise time shall be at least 400 μsec at 50% rated dimmer capacity as measured from 10-90% of the load current waveform at a 90° conduction angle, and at no point rise faster than 30mA/μsec. Manufacturers should note that additional filters may be required to meet this specification. These filters need not be integral to the dimming module, but must be integral to the dimming cabinet.
7. Dimmer output voltage shall be a minimum 95% of input voltage at maximum intensity setting.
8. Minimum and maximum light levels shall be user adjustable for each dimmer.

I. Integral Dimming

1. Preset dimming controls shall be capable of operating at rated capacity without adversely affecting design lifetime.
2. Preset dimming controls shall mount individually in standard 2, 3, or 4-gang U.S wall boxes.
3. Preset dimming controls shall operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F).
4. Preset dimming controls shall incorporate an airgap switch, which shall be accessible without removing faceplate. The airgap switch shall be capable of meeting applicable requirements of UL 20 for airgap switches in incandescent dimmers.
5. Preset dimming controls shall meet IEC 801-2, tested to withstand 15kV electrostatic discharge without damage or loss of memory.
6. Preset dimming controls shall meet ANSI/IEEE Std. C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges up to 200A without damage.
7. Preset dimming controls shall meet the UL 20 limited short circuit test requirement for snap switches.
8. Preset dimming controls shall be voltage regulated.
9. Preset dimming controls shall utilize an LC filtering network to minimize interference with properly installed radio, audio, and video equipment.
10. Minimum light levels shall be user adjustable in order to compensate for different sources and loading.
11. Separate power booster/interface(s) shall increase dimmer capacity. Capacity shall range from 1000W/VA to 30,000W/VA. Quantities and size of each type of power booster shall be provided to control each type of load shown on the load schedule and/or the drawings.

J. Wall Box Dimmers

1. All devices shall be UL listed specifically for the required loads (i.e., incandescent, fluorescent, low voltage, electronic low voltage). Manufacturer shall provide file card upon request. Universal dimmers shall not be acceptable.
2. Manufacturer shall maintain ISO 9001 certification. Provide a copy of the certificate as part of the submittal.
3. All dimmers and switches shall incorporate an air gap which shall be accessible without removing the faceplate. The air gap switch shall be capable of meeting all applicable requirements of UL 20 and UL 1472 for air gap switches in incandescent dimmers.
4. All dimmers and switches shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.
5. Dimmers and switches shall meet ANSI/IEEE Std.C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage.
6. Dimmers and switches shall meet the UL 20 and UL 1472 limited short circuit test requirement for snap switches.
7. Dimmer control shall be linear slide. Dimmer shall provide a smooth and continuous Square Law dimming curve.
8. Dimmer shall be voltage regulated so that +10% variation in line voltage shall cause not more than a +5% variation in load voltage when dimmer is operating at 40V (5% light output).
9. Dimmers shall utilize a LC filtering network to minimize interference with properly installed radio, audio, and video equipment.
10. Dimmer control slider shall be captured.
11. Faceplate shall snap on to device with no visible means of attachment. Heat-fins shall not be visible on front of device. At locations with multiple devices, one seamless, multi-gang faceplate shall be provided. Contractor is responsible for coordination of proper

back box size and faceplate type.

K. Four Scene Preset Control

1. Controls shall provide access to 4 preset lighting scenes and off for up to 8 control zones. Control shall be capable of storing an additional 12 preset lighting scenes. Scenes shall be changeable as required. Up to 8 controls may be tied together for more than 8 zones. Controls shall incorporate built-in wide angle infrared receiver, providing control via a separate a separate infrared wireless remote control transmitter from up to 50 feet away. Preset shall be set via easy-to-use raise/lower switches, one raise and lower switch per zone. The intensity for each zone shall be indicated via an illuminated bargraph Programming of preset scenes shall be accomplished without the use of an ENTER or STORE button. One or more zones may be temporarily overridden without altering the scene values which are stored in memory. Lighting levels shall fade smoothly between scenes at time intervals of 0-59 seconds or 1 to 60 minutes. The fade time shall be separately selectable for each scene. Additionally, control shall provide power failure memory for ten years.
2. Manufacturer shall maintain ISO 9001 certification. Provide a copy of the certificate as part of the submittal.

L. Accessory Control Options

Provide the following controls for use with the preset control(s) as shown on the drawings and/or described in LIGHTING CONTROL DESCRIPTIONS:

1. Two Scene Entrance Control(s) shall be capable of recalling Scene One plus Off, Scenes 7 and 8, or Scenes 13 and 14. Also can be used as raise/lower partition control and Lockout. All above based on dipswitch settings.
2. Four Scene Control(s) shall be capable of recalling any one of four scenes, master raise/lower, and Off. Control shall provide access to up to 16 scenes.
3. Fine Tuning Control(s) shall allow the temporary override of a particular zone or zones from the preset light level.
4. Infrared Wireless Transmitter(s) shall be capable of recalling any one of four preset scenes and Off. In addition, a master raise/lower shall be provided. The transmitter shall be manufactured by the dimming system manufacturer. The range of the transmitter to any single receiver shall be at least 50 feet. Wall receiver shall incorporate buttons for four scene select, master raise/lower, and off. Ceiling receiver shall provide 360° view and an integral LED to provide feedback of proper infrared signal.
5. Special Function Control(s) shall provide the following functions:
   a. Sequencing shall allow the user to set up and operate a sequence of 4, 12, or 60 steps. A sequence shall be defined as a series of steps, while a step shall be defined as the recall of a scene. Each step interval is adjustable from 1 second to 60 minutes.
   b. Zone lockout shall allow temporary changes without altering light levels preset for each scene.
   c. Scene lockout shall lockout the control, maintaining current scene and disabling all buttons on the preset dimming controls.
   d. Fade override shall set all fade times to zero.
6. Partition Control(s) shall provide two or four buttons for operating multiple preset units independently or in combination. Each button shall have a corresponding LED to indicate status of a specific partition “door.”
7. Photocell Interface Control(s) shall provide scene selection via daylight photosensor.
8. Equipment Interface(s) shall allow access to preset dimming control(s) via one of the following methods:

a. Isolated momentary/maintained dry contact closures. Where indicated on the drawings, each interface shall provide isolated maintained contact closures rated at 200mA at 30VDC for pilot light status feedback.
b. For use with four scene preset control, RS232 serial communication.
c. For use with four scene preset control, astronomic time clock with 60 events/day and 4 schedules.
d. For use with multiple area-centralized control, DMX512 interface with control of 32 continuous dimming zones via external DMX512 device.

M. Wiring of lighting controls shall comply with all applicable Sections of these Specifications, as well as manufacturer's specifications and local, state and/or national building, electrical and energy codes and regulations.

N. Equipment shall not use analog technology for communication.

O. Equipment shall be manufactured using surface mount technology.

2.2 LIGHTING CONTROL DESCRIPTIONS - SEE APPENDIX B.

PART 3 - EXECUTION

3.1 LOCATION

A. Locations of lighting controls are shown diagrammatically. Verify exact location and spacing with Plans, Sections and other reference data before ordering of lighting controls and during installation.

B. Notify Architect about field conditions at variance with Contract Documents before commencing installation.

C. Coordinate space conditions with other trades before ordering of lighting controls.

3.2 INSTALLATION

A. Wiring from dimming panel to preset dimming control and accessory controls shall be low voltage Class 2 wiring. All lighting control wiring shall be in an approved raceway specified in Section 26 05 33.

B. Provide accessories as required for construction type indicated on Finish Schedule. Lighting control catalog numbers do not necessarily denote specific mounting accessories for type of wall or surface in which a lighting control may be installed.

C. Provide adequate and sturdy support for each lighting control component. Contractor shall be responsible for verifying weight and mounting method of all lighting controls and furnishing and installing suitable supports. Lighting control mounting assemblies shall comply with all local codes and regulations.

D. Contractor shall be responsible for mounting the lighting controls at the proper depth, and for coordinating the cutout size and shape in wall to ensure that the faceplate covers the cutout entirely. Refer to drawings for location and mounting height of controls.

E. Install lighting controls with vent holes free of air-blocking obstacles.

F. Support elements shall not be mounted to or in contact with ducts or pipes.

G. Mask the lighting controls as necessary to protect the controls during construction.

H. At the completion of construction, clean the face plates and exposed surfaces of all lighting controls, so as to render them free of any material, substance or film foreign to the lighting control. Use soft, non-abrasive cloth and a cleaning solution recommended by the lighting control manufacturer. If the lighting controls are deemed dirty by the Architect at the completion of the project, the Contractor shall clean them at no additional cost to the Owner. Lighting control components whose finishes are damaged shall be replaced at no cost to the Owner.

I. Contractor shall furnish all equipment, labor and materials for the proper installation and system setup of all lighting controls and components as shown on drawings and as specified. System setup includes defining each dimmer's load type, assigning each load to a zone, and setting the control functions. System setup shall take place before building is turned over to Owner, after regular working hours where required.

3.3 FIELD SUPPORT

A. Upon completion of installation, the Manufacturer shall provide a qualified field technician to make one (1) visit to the project site for 5 days to assist the Contractor in commissioning the control system. Manufacturer to be capable of providing on-site service support within 24 hours anywhere in the continental U.S.A., and within five business days anywhere in the world, except where special visas are required.

B. A local factory-trained technician within 50 miles of the project is required. Spare parts should be stocked locally.

END OF SECTION

END OF SECTION 260933

SECTION 26 22 00 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.

B. Requirements of the following Division 26 Sections apply to this section.

1. “Electrical Requirements.”

1.2 SUMMARY

A. This section includes general purpose and specialty dry type transformer with winding rated 600V or less, with capacities up to 1000 Kva.

B. The work includes the providing of all labor, materials, equipment, accessories, services and tests necessary to complete and make ready for operation by the Owner. All dry type transformers shall be in accordance with Drawings and Specifications.

C. Related Sections: The following Division 26 Sections contain requirements that relate to this section:

1. “Electrical Identification” for signs associated with transformer installations.

D. All switchboards, panelboards, switchgears, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project.

1.3 SUBMITTALS

A. General: Prior to fabrication submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

1. Product data for each transformer, including dimensional plans view electrical rooms, sections, and elevations showing minimum clearances, installed devices, and material lists.
2. Wiring diagrams from manufacturer differentiating between manufacturer-installed and field-installed wiring.
3. Product certificates, signed by manufacturer of transformers certifying that their products comply with the specified requirements.
4. Product Test Reports: Certified copies of manufacturer’s design and routine factory tests required by the referenced standards.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: A firm member of NEMA who is regularly engaged in manufacturing components that comply with the requirements of these Specifications and that have been used on at least five projects of similar size and scope as this Project, and whose products have been in satisfactory use in similar service for not less then 10 years.

B. Provide dry type transformers produced by a manufacturer listed as an Approved Manufacturer in this Section.

C. Provide dry type transformers whose performance under specified conditions is certified by the manufacturer.

D. Field Testing Organization Qualifications: To qualify for acceptance, an independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code” , and applicable portions NECA’S “Standard of Installation” .

F. ANSI/IEEE Compliance: Comply with applicable requirements of ANSI/IEEE Standard including C2, “National Electrical Safety Code,” and C57.12.80, “Terminology for Power and Distribution Transformers.”

G. DOE 2016 LV Energy Efficiency levels as per DOE 10 CFR Part 431 – effective as of Jan. 1, 2016.

H. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.

I. Nationally Recognized Testing Laboratory Compliance (NRTL): Items provided under this section shall be NRTL listed and labeled. The term “NRTL” shall be as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 TRANSFORMERS, GENERAL

A. Transformers: Factory assembled and tested, air cooled units of types specified, having characteristics and ratings as indicated on drawings. Units shall be designed for 60 Hz service.

B. Cores: All cores shall be constructed of high grade, grain oriented non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point.

C. Coils: Continuous windings without splices except for taps.

D. Internal Coil Connections: The core laminations shall be clamped together with structural steel angles. The completed core and coil shall then be bolted to the base of the enclosure by isolator from the base of the enclosure by means of rubber vibration-absorbing mounts. There shall be no metal-to- metal contact between the core and coil and the enclosure. The vibration isolation system shall be designed to provide a permanent fastening of the core and coil to the enclosure. Sound isolating systems requiring the complete removal of all fastening devices will not be acceptable.

E. Wiring compartment and termination shall be accessible by removing enclosure front panels.

F. The use of fans to obtain rated KVA or TP-1 rating shall not be permitted for all transformer types.

G. Transformer "K" rating shall be K-13.

H. The entire transformer enclosure shall be degreased, cleaned, phos-phatized, primed, and finished with a grey baked enamel.

I. The maximum temperature of the top of the enclosure shall not exceed 35˚C rise above a 40˚C ambient.

J. Transformers 15 KVA through 75 KVA shall be designed so they can be either floor or wall mounted. Above 75 KVA they shall be floor mounted, design except as noted on drawings.

2.2 GENERAL PURPOSE, DRY-TYPE TRANSFORMERS

A. Comply with NEMA Standard ST 20 “Dry-Type” Transformers for General Applications.

B. Three phase transformers shall be 480 volt delta primary 208Y/120 Volt, 3-phase, 4-wire secondary unless otherwise noted. Other voltages shall be as shown on the drawings or otherwise required.

C. Windings: 2 winding type. Three phase transformers shall use one coil per phase in primary and secondary.

D. Provide aluminum windings.

E. Sound Level:
Sound levels shall not exceed NEMA ST-20 sound levels.

F. Each layer shall have end fillers, or tie downs, to provide maximum mechanical strength. Materials used shall have a minimum of one year of proven field usage. Insulation system shall be component recognized by Underwriter's Laboratories. The coils shall also have a final wrap of electrical insulating material to prevent mechanical injury to the wire as well as increasing the electrical breakdown strength. Coils with exposed wire will not be acceptable.

[NOTE TO SPEC WRITER: SELECT TEMPERATURE RISE: 115°C (80° C) (150°C). 115° C RISE PROVIDES 15% OVERLOAD CAPACITY. LOW TEMP RISE TRANSFORMERS SHOULD ONLY BE CONSIDERED IF THE TRANSFORMER WILL HAVE LOADS CLOSE TO THE NAMEPLATE KVA.]

G. Transformers shall have the following features and ratings:

1. Enclosure: Transformers 25 KVA and larger shall be in a heavy gauge, sheet steel, ventilated enclosure. The ventilating openings shall be designed to prevent accidental access to live parts in accordance with UL, NEMA, and National Electrical Code standards for ventilated enclosures. Outdoor transformers are to have rain-tight ventilation and a NEMA 3R rating.
2. Insulation Class: All insulating materials to be in accordance with NEMA ST-20 1972 standards for a 220˚C UL component recognized insulation system.
3. Basic Impulse Level: 10 kV for all 3-phase transformers.
4. Insulation Temperature Rise: Transformers 25 KVA and above shall be 115˚C temperature rise above 40˚C ambient unless otherwise noted. 115˚C rise in transformers shall be capable of carrying a 15% continuous overload without exceeding a 150˚C rise in a 40˚C ambient.
5. Taps: For transformer 3KVA and larger, full capacity taps in high-voltage winding as follows:
   a. 3 KVA through 30 KVA: Four 2.5% taps, two above and two below normal voltage.

b. 30 KVA through 500 KVA: Four 2.5% taps, two above and two below rated normal voltage.
c. 500 KVA through 1000 KVA: Four 2.5% taps, two above and two below rated normal voltage.
d. Step-up to higher voltage transformers shall include +/- (1) tap AN and BN at the minimum percentage available based on the amount of primary turns.

H. Accessories: As follows:

1. Wall mounting brackets: Manufacturers standard brackets for transformers sized between 15 KVA and 75 KVA where wall mounting is indicated on drawings.
2. Core and coil assemblies 30 KVA and larger to be mounted on rubber vibration isolators on concrete pads.

2.3 NOISE ISOLATION TRANSFORMER (WHERE INDICATED ON THE ONE-LINE DIAGRAMS)

A. Transformers: Factory assembled and tested, air cooled units of types specified, having characteristics and ratings as indicated on drawings. Units shall be designed for 60 Hz service.

B. Coils shall use high grade magnet wire. Coils shall have clearly marked terminal pads attached to a rugged fiberglass termination strip. Windings shall have continuous wire wound construction and shall be vacuum impregnated with nonhydroscopic thermosetting varnish for superior strength and heat transfer. Each layer shall have end fillers, or tie downs, to provide maximum mechanical strength. Materials used shall have a minimum of one year of proven field usage. Insulation system shall be component recognized by Underwriter's Laboratories. The coils shall also have a final wrap of electrical insulating material to prevent mechanical injury to the wire as well as increasing the electrical breakdown strength. Coils with exposed wire will not be acceptable.

C. Transformer shall have (2) 2.5 percent above nominal and (4) 2.5 percent below nominal universal full capacity taps.

D. Insulation system shall be UL Recognized at 220 degree C and shall be capable of continuous operation at 40 degree C ambient without windings exceeding 150 degree C temperature rise. Surface temperature rise shall not exceed UL 50 degree C limit. Wiring compartment temperature rise shall not exceed UL 35 degree C limit.

E. Floor mount enclosure shall be constructed of heavy gauge steel for indoor use. Weathershield kits shall be available to modify enclosures for NEMA 3R outdoor use.

F. Wiring compartment shall be sized for aluminum cable rated 125 percent of current, using long shanked crimp type connectors. Wiring compartment shall be accessible by removing enclosure front panel.

G. Vibration from core and coil assembly shall be isolated from enclosure by neoprene vibration pads and sleeves. A flexible copper grounding strap shall connect core to enclosure sized in accordance with applicable NEMA and NEC standards. A schematic connection diagram shall be located on enclosure nameplate for quick referral.

H. A premium electrostatic shield shall be included, consisting of a full width copper sheet placed between primary and secondary windings. Effective coupling capacitance shall be thirty picofarads. Average common mode noise attenuation shall be 120 db.

I. A rugged filter shall provide an average 60 db normal mode noise attenuation.

J. Surge suppression components shall be included to eliminate low voltage spikes and surges.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall examine location where this equipment is to be installed, determine space conditions and notify Architect/Engineer in writing of conditions detrimental to proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Install equipment where shown, in accordance with manufacturer's written instruction, and with recognized industry practices, to ensure that equipment complies with requirements and serves intended purposes.

C. Coordinate with other work as necessary to harmonize installation of transformers with other equipment in the area.

D. Coordinate installation of transformers with cable and raceways installation work.

E. Arrange equipment to provide adequate spacing for cooling air circulation.

F. Identify transformers in accordance with Division 26 Section “Electrical Identification.”

G. Tighten electrical connectors and terminals in accordance with manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Use flexible metal conduit to contain the conductors from the transformer to the raceway system.

3.2 EQUIPMENT BASES

A. Construct concrete equipment pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Construct base 4 inches high and 2 inches larger in all directions than the overall dimensions of the supported unit.
2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
3. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
4. Place concrete and allow to cure before installation of units. Use Portland Cement conforming to ASTM C 150, 4000 psi compressive strength, and normal weight aggregate.

B. Anchor mounting hardware firmly to walls, floors, or ceilings to ensure enclosures are permanently and mechanically secured. Provide all hardware and accessories for proper mounting including vibration mounts designed to suppress transformer noise and vibration.

3.3 GROUNDING

A. Ground transformers and tighten connections to comply with torque tightening requirements specified in UL Standard 486A.

3.4 FIELD QUALITY CONTROL

A. Inspect for physical damage, broken insulation, tightness of connections, defective wiring, and general condition.

B. Thoroughly clean unit prior to making any tests.

C. Perform insulation-resistance test. Calculate dielectric absorption ratio and polarization index. Make measurements from winding-to-winding and winding-to-ground. Test voltages and minimum resistance shall be in accordance with Table below:

Minimum dc Test Voltage	Recommended Minimum Insulation Resistance in Megohms
1000 volts	500

D. Verify taps and connect transformer to desired tap, if applicable.

E. Energize primary winding with system voltage. Measure secondary voltage with the secondary load disconnected. Record results.

3.5 ADJUSTING AND CLEANING

A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt and construction debris. Touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendations within enclosure of each transformer throughout periods during which equipment is not in a space that is continuously under normal control of temperature and humidity.

END OF SECTION 262200

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Material and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Provide all panelboards and enclosure work, including cabinets and cutout boxes, as indicated by drawings and schedules, and a specified herein.

B. Regardless of what the drawings reflect or indicate, all 480 Volt main switches shall be provided with ground fault. In healthcare buildings, all second level over current devices shall also be provided with ground fault.

C. Types of panelboards, and enclosures required for the project include the following:
1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

D. All switchboards, panelboards, switchgears, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project unless specifically noted otherwise.

E. Wires/cables, bus-way, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards, and enclosures are specified in other Division 26 sections.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on panelboards, and enclosures.

B. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

C. Submit electrical room plan view drawings at ¼” scale showing all equipment, panelboards, disconnects and ratings, buss work, conduit areas, dimensions and mounting of equipment supplied.

D. Shop drawings showing dimensions, voltage, phasing, continuous current capacity, and short circuit rating.

E. The equipment product data, electrical room layouts and short-circuit study shall be submitted together in order to provide proper evaluation.

F. Submittals shall be in accordance with specification section 26 05 00.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: The manufacturer of this equipment shall be regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required and have produced similar electrical equipment, for a minimum period of five (5) years. When requested

by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Codes and Standards
   1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of electrical panelboards and enclosures.
   2. UL Compliance: Comply with applicable requirements of UL 67, “Electric Panelboards”, and UL’s 50, 869, 486A, 486B, 891, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
   3. Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate UL markings which indicated that they are suitable for special type of use/application.
   4. NEMA Compliance: Comply with NEMA Standards Pub/No. 250, “Enclosure for Electrical Equipment (1000-Volts Maximum)”, Pub/No. PB 1, “Panelboards”, and Pub/No. PB 1.1, “Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600-Volts or Less”.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store panelboards in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic; where necessary to store outdoors, store electrical components above grade and enclose with watertight wrapping.

B. Handle panelboards carefully to prevent internal components damage, breakage, denting, and scoring enclosure finish. Do not install damaged components; replace and return damaged units to equipment manufacturer.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.1 PANELBOARDS (1600 AMPS OR LESS)

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated on drawings, which comply with manufacturer’s standard materials; with the design and construction in accordance with published product information; equip with proper numbers of unit panelboard devices as required for complete installation.

   1. Prefabricated or pre-wired panelboards are not acceptable.

B. Power and Distribution Panelboards: Provide dead-front safety type power distribution panelboards as indicated, with panelboards switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Select unit with feeders connecting at top of panel. Equip with copper buss bars with not less than 98% conductivity, and with full-sized neutral buss; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connection. Provide fused main and branch overcurrent device types for each circuit. Provide

common trip so overload on one pole will trip all poles simultaneously. Provide panelboards with bare un-insulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturers as panelboards, which mate and match properly with panelboards. Employ overcurrent devices that are fully rated for the available short-circuit condition.

C. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown. Equipped with anti-turn solderless pressure type lug connectors approved for use with copper conductors; equip with copper buss bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, circuit breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral buss for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturers as panelboards, which mate and match properly with panelboards.
   1. Employ breakers that are fully rated for the available short-circuit condition but not less than 10,000 sym AIC at 120/208-Volts; and 14,000 sym AIC at 277/480-Volts.
   2. Where multiple single pole breakers share a common neutral conductor, provide breaker tie bars as required so overload on one pole will trip all poles simultaneously.
   3. All circuit breakers feeding food service loads or vending machines shall be GFCI type.

D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts hinged to box, and doors with flush locks and keys, all panelboard enclosures keyed alike. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for surface mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

E. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and ampere ratings as indicated on the drawings. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in ambient temperature of 40°C. Provide breakers with mechanical screw or compression type removable connector lugs, AL/CU rated. The breakers for 277/480V panelboards shall be industrial grade; breakers that allow or direct particles of combustion resulting from fault conditions out of the breaker are not acceptable, they shall be contained within its casing. For example; GE AE series panelboards with TEY circuit breakers are not acceptable, TED breakers are acceptable.
   1. Breakers feeding the primary side of a transformer shall have provisions for locking the breaker on or off.

F. Emergency and Standby Fused Lighting and Appliance Coordination Type Panelboard

(Note: Breaker panelboards may be utilized if manufacturer provides confirmation that system is coordinated to requirements of the AHJ.)
   1. Provide dead front safety type fused coordination panelboard(s) with overcurrent and switching devices consisting of series connected branch circuit breakers, lockable in the OFF position and Class CC or Class J fuses in rejection dead-front fuse holders. Provide with copper bussing throughout.
   2. Panelboard shall have voltage and current ratings as specified on the drawings including:

a. 120/208V, 3PH, 4W
b. 120/240V, 1PH, 3W
c. 277/480V, 3PH, 4W

3. Panelboard shall have been successfully tested for a short-circuit-current-rating of at least 100,000 amps AC RMS symmetrical at the specified voltage on the drawing.
4. Panelboard shall be selectively coordinated with all upstream overcurrent protective devices in accordance with NEC 700.27, 701.18, 517.26 and 708.54.
5. Refer to project panel schedules for the panelboard circuit configuration, bus capacity, voltage, branch device sizes, enclosure type, mounting, rating, type of mains, etc.
6. Panelboard may require main circuit breaker or provide with Class T Main Fuse Switch ampere ratings is specified on the drawing.
7. Bus bars shall be tin-plated copper with sufficient cross sectional area to meet UL 67 temperature rise requirements. Provide fully rated neutral bar. Lugs on neutral and ground bars shall be sized to accommodate required feeders.
8. All panels fed from the emergency distribution shall accommodate an external Surge Protective Device (SPD). Refer to section 26 43 14.
9. Refer to 26 05 03 for acceptable manufacturers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area and conditions under which panelboards and enclosures are to be installed, and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation" and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque tightening requirements specified in UL Standards 486A and B.

C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

D. Provide properly wired electrical connections for panelboards within the enclosures.
1. Prefabricated or pre-wired panelboards are not acceptable.

E. Provide engraved, plastic laminate labels for all panelboards indicating name, voltage, phase, wire and short circuit rating. Refer to Section 26 05 53 for more information.

F. At all recessed panel locations, provide three ¾" spare conduits stubbed to the accessible ceiling space for future use.

G. Provide typed panelboards circuit directory card upon completion of installation work to match as-built conditions and nomenclature indicated on engineering drawings and submit directories to the Engineer for review prior to mounting in panelboard.

3.3 GROUNDING

A. Provide equipment grounding connections as indicated herein. Tighten connection to comply with torque tightening requirements specified in UL Standard 486A to assure permanent and effective grounds.

B. Refer to Section 26 05 26 for additional grounding requirements.

3.4 FIELD QUALITY CONTROL

Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment".

A. Infrared Inspection (After Energized)
   1. The scan is to include all electrical panelboards or bussed distribution equipment.
   2. All equipment should be energized at normal load levels during an event for at least 1 to 2 hours prior to being scanned.
   3. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.
   4. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
   5. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

B. Panelboards:
   1. Visual and Mechanical Inspection:
      a. Inspect for physical damage and code violations.
      b. Inspect for proper alignment, anchorage and grounding.
      c. Inspect for proper identification of protective devices and switches.
      d. Check tightness of accessible bolted buss joints.
      e. Physically test all electrical or mechanical interlocks to assure proper function.
      f. Clean interior and insulator surfaces once a month prior to job completion.
      g. Inspect for proper operation of space heaters and thermostat settings (if they exist).
   2. Electrical Tests:
      a. Measure insulation resistance of each buss section phase-to-phase and phase-to-ground.
      b. Check panelboards for electrical continuity of circuits and for short circuits.

3.5 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION

A. Subsequent to wire and cable hook-ups, energize and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles
2. Ground Fault Circuit Interrupter Receptacles
3. Plugs
4. Plug Connectors
5. Switches
6. Wall Plates

1.3 SUBMITTALS

A. Product data for each type of product specified. Include a color selection chart showing available color for each device type.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes.

1. NFPA 70 “National Electrical Code.”

B. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.5 SEQUENCE AND SCHEDULING

A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards.

B. Color of Devices: Color of all devices shall be coordinated with the Architect, except special purpose devices shall be black, emergency power system devices which shall be red, corrosion-resistant devices which shall be yellow, surge suppression devices shall be blue, or isolated ground devices which shall be orange.

C. Receptacles: As scheduled in Table 1 in Part 3 indicated herein. Comply with UL 498 and NEMA WD 1 and WD 5.

D. Receptacles, Industrial Heavy Duty: Provide pin and sleeve design receptacles conforming to UL 498. Comply with UL 1010 where installed in hazardous locations. Provide features indicated.

E. All receptacles fed from emergency generator power upon normal power failure, shall be "Hospital Grade" type. Cover shall be steel with red baked enamel. Receptacles connected to emergency power shall be colored red and durably marked to indicate panelboard and circuit number supplying them.

F. Ground-Fault Interrupter (GFI) Receptacles: As scheduled in Tables 1 and 2 in Part 3 indicated herein: Provide “terminal” or feed-through type ground-fault circuit interrupter, as indicated on drawings, with integral heavy-duty NEMA 5-20R duplex receptacles. Provide unit designed for installation in a 2-3/4-inch deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943.

G. All single receptacles or multi-outlet receptacle assemblies in lab areas shall be labeled with panel and circuit breaker.

H. Receptacles for Health Care Facilities: As scheduled in Table 2 in Part 3 indicated herein.

I. In health care facilities, all receptacles shall be labeled with panel and circuit breaker.

J. All 15A and 20A, 125V and 250V, non-locking receptacles located in damp or wet locations shall be listed weather-resistant type.

K. Provide Firestop putty pads on the backside of all boxes exceeding 16 sq. inches in area. Provide Firestop putty pads on the back side for all outlet boxes within 24 inches of each other, in opposite sides, and at same elevation, in the same wall. Provide Firestop putty pads on the back side for all boxes in a wall or ceiling where the aggregate surface area of the outlet boxes exceeds 100 sq. inches per 100 sf of surface of wall or ceiling area. Firestop putty pads shall be Hilti CP617XL (9” x 9”) for each box 16 sq inches or less.

L. Snap Switches: As scheduled in Table 2 in Part 3 indicated herein:

M. Wall Dimmer: refer to lighting control details for information.

N. Floor Outlets: Floor boxes shall be concealed service, fully adjustable cast iron, watertight type for single or multi-gang installations. Floor box shall have space for both 120 volt and telecommunication wiring. Service fittings, covers, and accessories shall be brass. Service fittings shall be in floor flush type with outlet devices as indicated on the drawings. Provide covers, extensions, adapters and necessary components to provide the service type indicated on the drawings. Install carpet flange on all outlets in carpeted areas.

O. Wireways:

1. Wiring troughs shall be 4" x 4" or 6" x 6", brake-formed of code gauge steel, furnished in standard 10-foot sections with knock- outs, as required. Wiring troughs shall be of the screw cover type and shall have a high grade enamel finish baked on a chemically-cleaned and zinc-phosphatized surface providing maximum resistance to corrosion.
2. Wiring troughs shall be furnished with all the required components, such as square junction boxes, 90-degree elbows, T-shaped pull boxes, crossover pull boxes, box-connecting couplings, fittings and screw-on cover plates. Lengths of individual sections shall be provided in accordance with installation requirements.

P. All devices shall be premium specification grade.

2.2 WIRING DEVICE ACCESSORIES

A. Wall Plates: Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plates with engraved legend where indicated on drawings. Engraving shall be done by the device manufacturer. All lettering shall be 1/8-inch high and shall be black for normal power systems and red for emergency power systems. Provide plates possessing the following additional construction features:

1. Material and Finish: 0.04 inch thick, type 302 satin finished stainless steel. Plate shall be Hubbell “S” Series or approved equal.
2. Surface mounted wiring devices and blank outlet plates shall be cadmium plated. Interior outlet plates shall be pressed steel. Outlets exposed to weather or corrosive conditions shall be of the cast-metal type.
3. Plates for weatherproof receptacles shall consist of cast- aluminum gasketed plate with spring-loaded lift covers providing access to the outlet. Lift cover to correspond to number of outlets to be gasketed. Plates for weatherproof switches shall consist of a cast plate with flexible bubble for activating a push type switch. Plates shall be for corrosion-resistant devices, as manufactured by Hubbell, Inc., or approved equal.

B. For all devices installed which are exposed to the weather, moisture or where indicated on the drawings, device plates shall be weatherproof. Device plates shall be cast type with gasketing to prevent entrance of moisture when closed.

PART 3 - EXECUTION

3.1 INSPECTION

A. Contractor shall examine location where wiring devices and installation components are to be installed and determine space conditions and notify architect in writing of conditions detrimental to proper and timely completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRING DEVICES AND ACCESSORIES

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.

C. The mounting height of devices is indicated in the legend on the drawings. Where finished walls are exposed concrete block, brick or tile, the height shall be adjusted to allow outlet box for device to be mounted at a joint.

D. Receptacles above countertops shall be installed with major axis horizontal above the backsplash.

E. Electrical outlets shall be installed vertically unless otherwise noted. Those located on interior columns shall be centered laterally.

F. Mount all devices within outlet boxes to allow device plates to be in contact with wall on all sides. Align devices with major axis of device parallel to adjacent predominant building feature, i.e., door frames or countertops.

G. Install wall switches on the strike side of doors.

H. Mount switches with the long dimension vertical and the operating handle in the upward position when in the "On" position.

I. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

J. Provide a current carrying conductor, neutral, equipment grounding conductor and an insulated grounding conductor to each isolated ground "IG" receptacle.

K. Install galvanized steel wall plates in unfinished spaces.

L. Install wiring devices after wiring work is completed.

M. Install wall plates after painting work is completed.

N. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torque requirements are not indicated, tighten connectors and terminal to comply with tightening torque requirements specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

O. At time of completion, replace items which have been damaged including those burned and scored by faulty plugs.

P. Where it is not possible to set the switch box flush with the wall, furnish raised edge plates.

Q. Where more than one switch is being installed, provide multiple gang switch plates for number of switches as required.

3.3 PROTECTION

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.4 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing test wiring devices and demonstrating compliance with requirements, operate each operable device at least six times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

C. TABLE 1

RECEPTACLES FOR HOSPITAL CARE FACILITIES

Designation (1)	Current Rating Amps	Voltage Rating	Single/ Duplex	NEMA Config.	Hubbell Catalog #(3)	Notes
-	20	125	Duplex	5-20R	HBL8300	-
-	20	125	Simplex	5-20R	HBL8310	-
GFI	20	125	Duplex	5-20R	GFR8300HL	Integral GFI (2)
-	20	125	Duplex	5-20R	HBL8300SGA	Tamper-proof

NOTES

1. Letter designations are used where symbols alone do not clearly designate on plans locations where specific receptacle types are used.
2. Protecting downstream receptacles on same circuit is not acceptable.
3. Refer to Section 26 05 05 for additional acceptable manufacturers. Color of device shall be verified with Architect (ivory, gray, white, etc.). All emergency receptacles shall be red.
4. Where required per NEC or local code provide ‘WP26M’ in-use water-proof cover.

D. TABLE 2

SWITCHES

Designation (1)	Typical Application	Load Rating	Voltage Rating (AC)	Poles	Hubbell Catalog #(2)	Notes
S	Control Lights	20A	120/277	1	DS120	-
S3	Control Lights	20A	120/277	3-way	DS320	-
S4	Control Lights	20A	120/277	4-way	DS420	

NOTES

1. For snap switches, designation is the same as the symbol used on plans for the device. Type of switch is determined from plan context including type of device or circuit being controlled.
2. Refer to Section 26 05 05 for additional acceptable manufacturers. Color of device shall be verified with Architect (ivory, gray, white, etc.).

END OF SECTION 262726

SECTION 262816 - DISCONNECTS, FUSES AND ENCLOSED BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Materials and Methods sections, apply to work of this section.

1.2 SUMMARY

A. Provide all circuit and motor disconnect switch and circuit breaker work including fusing, electrical connections to motors, appliance and mechanical equipment as indicated on the drawings and schedules.

B. All disconnects serving smoke fans/motors shall have auxiliary contact wired to control circuit of upstream starter/VFD to monitor the position of the disconnect.

C. Types of circuit and motor disconnect switches in this section include the following:

1. Equipment disconnects.
2. Appliance disconnects.
3. Motor-circuit disconnects.
4. Enclosed circuit breakers.

D. Applications of electrical power connections specified in this section include the following:

1. To resistive heaters.
2. From electrical source to motor starters.
3. From motor starters to motors.
4. To lighting fixtures.
5. To converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment.
6. To grounds including earthing connections.
7. To panelboards, contactors, and similar equipment.
8. Enclosed busway plug-in assemblies.

E. All switchboards, panelboards, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on circuit and motor disconnect switches, fuses, equipment connectors.

B. Fuse Product Data: For each type of fuse indicated. Include construction details, material, dimensions, descriptions of individual components. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings:

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Fuse sizes for elevator feeders and elevator disconnect switches, and circuit breakers.

1.4 QUALITY ASSURANCE

A. All equipment shall be in compliance with codes and standards referenced in Section 26 05 02 titled "Electrical Requirements".

B. "Manufacturers" - Firms regularly engaged in manufacture of the type of equipment required for the application, whose products have been in satisfactory use in similar service for not less than 5 years.

C. UL Compliance: Comply with requirements of UL 98, "Enclosed and Dead-Front Switches." Provide circuit and motor disconnect switches which have been UL listed and labeled.

D. Comply with NEC (NFPA 70) for construction and installation of safety and disconnect switches.

E. Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors," including, but not limited to, tightening of electrical connectors to torque values indicated.

F. NEMA Compliance: Comply with applicable requirements for NEMA Stds Pub/No. KS 1, "Enclosed Switches," and No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

G. ANSI Compliance: Comply with applicable requirements of ANSI C97.1, "Low-Voltage Cartridge Fuses 600 Volts or Less."

H. NEMA Compliance: Comply with NEMA FU1 for cartridge fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

B. Molded case circuit breakers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of the following:

1. UL 489 – Molded Case Circuit Breakers
2. NEMA AB1 – Molded Case Circuit Breakers
3. NEMA 250 – Enclosures for Electrical Equipment

PART 2 - PRODUCTS

2.1 CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Furnish and install safety switches as required for motor outlets or other equipment. Switches shall be of size, number of poles, and fused or non-fused, as required for job conditions and the National Electrical Code.

B. Switches shall be equipped with fuse contacts and jaws which ensure positive fuse and jaw contact by means of reinforcing spring clips of other approved means. All current carrying parts shall be silver-plated. Hinges shall be non-current carrying. Switches shall be so designed that they can be locked in either open or closed position.

C. All switches shall have switch blades which are fully visible in the OFF position when the door is open. Switches shall have removable arc suppressors, where necessary to permit easy access to line-side lugs. Lugs shall be UL listed for aluminum and/or copper cables and front removable. 30A thru 100A switches shall have provisions for field installed fuse pullers. Switches shall include solid neutral where required.

D. All safety switches shall be NEMA 1 enclosed Type “HD” (heavy duty) quick-make, quick-break, and have interlocking cover with handle that may either be front or side operating with padlocking provisions. Provide NEMA 3R weather proof enclosures where indicated on the drawings or exposed to exterior or damp locations. Incorporate rejection clips where used with Class “R” fuses.

E. Handle position shall indicate if switch is ON or OFF. Handle shall have provision for padlock.

F. Switches shall be rated for voltage, poles, amperes, and horsepower, as required or shown on Drawings. All switches shall be rated for maximum available fault current as required or shown on Drawings.

G. Fusible Switches: Heavy duty switches, with fuses of classes and current ratings indicated on drawings. See Section “2.3” for Fuse specifications. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.

H. Non-fusible Disconnects: Heavy duty switches of classes and current ratings as indicated on drawings.

I. Double-Throw Switches: Heavy duty switches of classes and current rating as indicated on drawings.

J. Bolted Pressure Switches: Bolted pressure switches conforming to and listed under UL Standard 977; single or double-throw arrangement as indicated. For fusible units provide fuses as indicated on drawings.

K. Accessories:

1. Electrical Interlocks: Provide number and arrangement of interlock contacts in switches as indicated on drawings or specified elsewhere in specifications.
2. Special Enclosure Material: Provide special enclosure material as follows for switches indicated on drawings to be NEMA 4X:

   a. Stainless Steel Type 316.
   b. Heavy case aluminum.
3. Captive Fuse Pullers: Provide built-in pullers arranged to facilitate fuse removal.

2.2 CONNECTIONS FOR EQUIPMENT

A. General: For each electrical connection indicated provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, electrical solder, electrical soldering flux, heat-shrinkable insulating tubing, cable ties, solderless wirenuts. All other items and accessories as needed to complete splices and terminations of types indicated.

B. Metal Conduit, Tubing and Fittings:

1. General: Provide metal conduit, tubing and fitting of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Section 26 05 06 titled “Basic Materials and Methods” and Section 26 05 33 titled “Raceways and Boxes” and in accordance with the following listing of metal conduit, tubing and fittings:

   a. Rigid steel conduit.
   b. Rigid metal conduit fittings.
   c. Electrical metallic tubing.
   d. EMT fittings.
   e. Flexible metal conduit.
   f. Flexible metal conduit fittings.
   g. Liquid-tight flexible metal conduit.
   h. Liquid tight flexible metal conduit fittings.

C. Wires, Cables, and Connectors:

1. General: Provide wires, cables and connectors complying with Division 26 05 06 titled “Basic Materials and Methods” and “Section 26 05 19” titled “Wires and Cables.”
2. Wires/Cables: Unless otherwise indicated, provide wires/cables (conductors) for electrical connections which match, including sizes and rating, of wires/cables which are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).
3. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended for use by equipment manufacturer for intended applications.

4. Electrical Connection Accessories: Provide electrical insulating tape, heat shrinkable insulating tubing and boots, electrical solder, electrical soldering flux, wirenuts and cable ties as recommended for use by accessories manufacturers for type services indicated.

2.3 FUSES

A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time-current and peak let-through current characteristics, which comply with manufacturer's standard design, materials, and constructed in accordance with published product information, and with industry standards and configurations.

B. Class RK1 dual element time-delay fuses: Provide UL Class RK1 current limiting time-delay fuses rated 600-volts, (250 volts where specified), 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting circuit breakers, motors and panelboards.

C. Class RK5 dual element time-delay fuses: Provide UL Class RK5 current limiting time-delay fuses rated 600 volts, (250 volts where specified), 60 Hz, with 200,000 RMS symmetrical interrupting current rating for protecting circuit breakers, motors, and transformers.

D. Class L time-delay fuses: Provide UL Class L time-delay fuses rated 600 volts, 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

2.4 MOLDED CASE PROTECTIVE DEVICES

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

D. The Contractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition. The settings shall be in accordance with the approved protective device coordination study or as directed by the Engineer.

2.5 ENCLOSURES

A. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. Nema 1 surface of flush-mounted general purpose enclosures intended for indoor use.

B. All enclosed circuit breakers shall have nameplates that contain a permanent record of catalog number and maximum rating.

C. Provide handle mechanisms that are pad-lockable in the "OFF" position.

PART 3 - EXECUTION

3.1 INSPECTION

A. Contractor shall examine location where fuses and safety and disconnect switches and circuit breakers are to be installed and notify Architect/Engineer in writing of conditions detrimental to proper and timely/completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECT SWITCHES

A. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Coordinate circuit and motor disconnect switch installation work with electrical raceway and cable work, as necessary for proper interface.

C. Install disconnect switches for use with motor-driven appliances, and motors and controllers within sight of controller position unless otherwise indicated. For all disconnecting means located remote from the motor controller (starter or variable frequency drive), contractor to provide disconnect with auxiliary contacts, contacts and control wiring back to motor controller.

D. Provide NEMA 3R disconnect switches for all exterior locations and any location subject to moisture.

E. Provide box with spare set of each size fuse used on job.

F. Provide nameplate on switch, indicating equipment served.

G. Provide line voltage wiring from starter/VFD control circuit to Aux contact in disconnect. Provide 2# 10, 3/4" C or run with power wire if same voltage.

3.3 INSTALLATION OF EQUIPMENT CONNECTIONS

A. Install electrical connections in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of installation" to ensure that products fulfill requirements.

B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.

C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.

E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires and terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "nicking" copper conductors while skinning wire.

F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torque tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torque requirements are not available, tighten connectors and terminals to comply with torque values contained in UL 486A.

H. Provide PVC-coated conduit and fittings for highly-corrosive atmospheres.

I. Provide flexible conduit for motor connections, and other electrical equipment connections, where subject to movement and vibration.

J. Provide liquid-tight flexible conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:

1. Exterior location.
2. Moist of humid atmosphere where condensation can be expected to accumulate.
3. Corrosive atmosphere.
4. Water spray.
5. Dripping oil, grease, or water.

K. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number in accordance with Division 26 section titled "Electrical Identification." Affix markers on each terminal conductor, as close as possible to the point of connection.

L. Provide flexible metal conduit or Type "S" rubber cords, pigtails, caps, etc., as required to constitute an operating system. All flexible cords shall have a grounding conductors. Ground all equipment. See Section 26 05 26 titled "Grounding" for additional requirements.

M. Prior to roughing-in, refer to all equipment manufacturer's shop drawings for details of equipment connections. Provide receptacles as required to match the cord caps on the equipment furnished. Provide either direct wiring or receptacles for final connection to equipment as required for the particular equipment furnished regardless of the type of outlet shown on the plans.

3.4 INSTALLATION OF FUSES

A. Install fuses as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC, and NEMA standards for installation of fuses.

B. Coordinate work including electrical wiring, as necessary, to interface installation of fuses with other trades.

C. Install fuses in fused switches.

D. Contractor shall install Class R fuse rejection kits on all heavy duty safety switches not already fitted for Class R fuses.

3.5 INSTALLATION OF ENCLOSED CIRCUIT BREAKERS

A. Install enclosed circuit breakers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation," and in accordance with recognized industry practices.

B. Coordinate enclosed circuit breakers installation work with electrical raceway and cable work, as necessary for proper interface.

3.6 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground for electrical disconnect switches.

3.7 FIELD QUALITY CONTROL

A. Testing: Subsequent to completion of installation of electrical disconnect switches and circuit breakers, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

B. Upon completion of installation of fuses, test and inspect system to ensure compliance with requirements.

C. Final tests and inspections of fuses shall be made prior to energization of the equipment. This shall include a thorough cleaning, tightening and review of all electrical connections and inspection of all grounding conductors.

END OF SECTION 262813

SECTION 262913 - MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Materials and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Extent of motor controller work is indicated by drawings and schedules.

B. Types of motor controllers specified in this section include the following:

1. Combination.
2. Fractional HP manual.

C. Work of this section includes wires/cables, raceways, electrical boxes and fittings, as specified in Division 26 sections, and used in conjunction with motor controllers.

D. Refer to applicable Division 26 sections for wires/cables, electrical raceways, and boxes and fittings required in connection with motor controllers.

E. All motor controllers, switchboards, panelboards, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the project.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data and installation instructions or motor controllers.

B. Shop Drawings: Submit shop drawings of motor controllers showing accurately scaled equipment locations and spatial relationships to associated motors and equipment.

C. Wiring Diagrams: Submit power and control wiring diagrams for motor controllers showing connections to electrical power panels, feeders, and equipment. Differentiate between portions of wiring which are manufacturer-installed and portions which are field-installed.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualification: Firms regularly engaged in manufacture of motor controllers of types and sizes required, whose products have been in satisfactory use in similar service for no less than 5 years.

B. Installer’s Qualifications: Firms with at least 5 years of successful installation experience with projects utilizing motor controller work similar to that required for this project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC Articles 220, 250, and 430, as applicable to installation, and construction of motor controllers.
2. NFPA Compliance: Comply with applicable requirements of NFPA 70E, “Standard for Electrical Safety Requirements for Employee Workplaces.”
3. UL Compliance: Comply with applicable requirements of UL 486A and 486B, and components which are UL-listed and labeled.
4. IEEE Compliance: Comply with recommended practices contained in IEEE Standard 241, “Recommended Practice for Electric Power Systems in Commercial Buildings,” pertaining to motor controllers.
5. NEMA Compliance: Comply with applicable requirements of NEMA Standard ICS 2, “Industrial Control Devices, Controllers and Assemblies,” and Pub/No. 250, “Enclosures for Electrical Equipment (1000 Volts Maximum),” pertaining to motor controllers and enclosures.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver motor controllers and components properly packaged in factory-fabricated type containers.

B. Store motor controllers and components in original packaging and in a clean dry space; protect from weather and construction traffic.

C. Handle motor controllers and components carefully to avoid breakage’s, impacts, denting and scoring finishes. Do not install damaged equipment; replace and return damaged units to equipment manufacturer.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceway, to properly interface installation of motor controllers with other work.

B. Sequence motor controller installation work with other work to minimize possibility of damage and soiling during remainder of construction period.

1.7 MAINTENANCE

A. Maintenance Data: Submit maintenance data and parts list for each motor controller and component; including “troubleshooting” maintenance guide. Include that data, product data and shop drawings in a maintenance manual; in accordance with requirements of Division 1.

B. Maintenance Stock, Fuses: For types and rating required, furnish additional fuses, amounting to one unit for every 10 installed units, but not less than 5 units each.

PART 2 - PRODUCTS

2.1 MOTOR CONTROLLERS

A. General: Except as otherwise indicated, provide motor controllers and ancillary components which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation.

B. Combination Controllers: Provide full-voltage alternating-current combination nonreversing controllers. Controllers shall consist of variable frequency drivers or motor circuit protector and disconnect switch mounted in common enclosure, of types, sizes, rating, and NEMA sizes shown on drawings. Each starter shall have a 120-volt, 60 Hz, control power transformer, H-O-A selector switch, red run pilot light, single phase protection and (2) two sets of N.O. and N.C. contacts for the building automation system. Equip controllers with block type manual reset overload relays and with fusible disconnect switches. Provide operating handle for disconnect switch mechanism with indication and control of switch position, with enclosure door either opened or closed, and capable of being locked in OFF position with three padlocks. Construct and mount controllers and disconnect switches in single NEMA Type 1 enclosure; coat with manufacturer's standard color finish. Provide NEMA 3R where installed in an exterior or damp location.

C. Provide start time delay relay with range 0-300 seconds for all motors 10 HP and larger. Set each relay 4 seconds apart for sequenced start-up after loss and restoration of normal power.

D. Fractional HP Manual Controllers: Provide single-phase fractional HP manual motor controllers, of sizes and ratings shown on drawings. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Controller to become inoperative when thermal unit is removed. Provide controllers with double break silver-alloy contacts, visible from both sides of controller; green pilot lights, and switch capable of being padlocked OFF. Enclose controller unit in NEMA Type 1 general purpose enclosure; coat with manufacturer's standard color finish. Provide NEMA 3R where installed in an exterior or damp location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which motor controllers are to be installed, and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MOTOR CONTROLLERS

A. Install motor controllers in accordance with equipment manufacturer's written instructions and with recognized industry practices; complying with applicable requirements of NEC, UL and NEMA standards, to ensure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to

comply with torque requirements specified in UL Standards 486A and 486B, and the National Electrical Code.

3.3 FIELD QUALITY CONTROL

A. Prior to energization of motor controller equipment, check with ground resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, check circuitry for electrical continuity, and for short circuits.

C. Ensure that direction of rotation of each motor fulfills requirements.

3.4 GROUNDING

A. Provide equipment grounding connections for motor controller equipment. Tighten connections to comply with torque tightening requirements specified in UL Standard 486A to assure permanent and effective grounding.

3.5 ADJUSTING AND CLEANING

A. Adjust operating mechanisms, where necessary, for free mechanical movement.

B. Touch-up scratched or marred enclosure surfaces to match original finishes.

3.6 DEMONSTRATION

A. Upon completion of installation of motor controller equipment and electrical circuitry, energize controller circuitry and demonstrate functioning of equipment in accordance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and retest to demonstrate compliance.

END OF SECTION 262913

SECTION 26 51 00 – LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including general and supplementary conditions and Division-1 Specification sections, apply to work of this section.

B. Division-26 Basic Electrical Materials and Methods sections apply to work specified in this section.

C. Refer to Architectural Drawings for light fixture schedule.

1.2 SUMMARY

A. Extent, location, and details of lighting fixture work are indicated on drawings and in schedules.

B. Types of lighting fixtures in this section include the following:

1. Light Emitting Diode, LED
2. Other lamps as noted on fixture schedule.

C. Fixture: A complete lighting unit, including lamps, wiring, controls and parts required to securely support fixture.

D. Exact ceiling construction shall be verified prior to ordering. Minor changes in ceiling construction shall not be an extra cost to the project.

1. All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this Contract shall be furnished by the Contractor.
2. Fixtures shall be manufactured in strict conformance with the Contract Drawings and Specifications.
3. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary of the work.
4. Minor details, not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
5. The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc., which may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this specification rests with the Contractor.

E. Where a catalog number and a narrative or pictorial description is provided, the written description shall take precedence and prevail.

F. General Contractor shall provide electrical subcontractor with entire lighting specification (including fixture illustrations and sketches); electrical subcontractor shall provide each specified manufacturer with complete information about the fixtures they will supply.

G. The contractor shall include the installation of an additional 2 exit signs with back boxes and conduit circuited and operational, in the base price for future request for exit signs by the Fire Department or Building Official. Place in field as directed.

H. Fixture details shown may be modified by the manufacturer provided all of the following conditions have been met:

1. Fixture performance is equal or improved.
2. Structural, mechanical, electrical, safety, and maintenance characteristics are equal or improved.
3. Cost to the Owner is reduced or equal.
4. Modifications have been reviewed by the Architect and have been approved by the Architect in writing.

1.3 SUBMITTALS

Submit shop drawings, samples, and prototypes as specifically instructed below.

A. Shop drawings shall include but not be limited to:

1. For standard catalog items with no modifications, submit catalog cut sheets prepared by the manufacturer which clearly show all elements to be supplied and all corresponding product data (including lamping; ballast manufacturer and model number; voltage; accessories or options and any miscellaneous items detailed in the written description of the specification). If cut sheet shows more than one (1) fixture type, all non-applicable information shall be crossed out.
2. For lamps, submit catalog cut sheets prepared by the manufacturer which clearly shows, manufacturer, CRI, CT, wattage, base type, lumen output, lamp life, and any other pertinent information.
3. For all submittals under paragraphs 1 through 3 above, manufacturer shall provide submittals within two weeks of receipt of order. All submittals shall have project name and fixture type clearly shown.
4. The Architect/Engineer shall make the final determination as to whether or not the submittal contains sufficient information and reserves the right to request a shop drawing if the fixture cut is insufficient.
5. Maintenance Data: Submit maintenance data and parts list for each lighting fixture, accessory and also include “trouble-shooting” maintenance guide. In addition to the product data and shop drawings, a maintenance manual in accordance with general requirements of Division 1 shall be provided.

B. Substitutions: Manufacturers or light fixtures not listed on fixture schedule must be prequalified prior to bid. For approval of all manufacturer/fixture substitutions, the bidders shall comply to specifications herein and as outlined below for submitting alternate fixtures:

1. No substitutions shall be accepted when the LIGHT FIXTURE SCHEDULE includes a three name manufacturer specification.

2. Should only one manufacturer be listed, with no “Approved alternate” statement, no substitutions are allowed. It is accompanied by a dollar allowance to allow for budgeting by other providers.
3. Light fixture bids must be priced separately and shall not be bundled with any other material or product bids, including but not limited to lighting control devices and lighting control systems.
4. Manufacturer shall have not less than five years experience in design and manufacture of lighting fixtures of the type and quality shown. Prequalification submissions must include a list of completed projects and data catalogue pages and drawings indicating length of experience.
5. Bidders wishing to obtain approval on brands other than those specified by name and catalog number or as an approved alternate in LIGHTING FIXTURE SCHEDULE shall submit their requests not later than fifteen (15) business days before the bid opening. Approval will be in the form of an addendum to the specifications issued to all prospective bidders indicating that the additional brand or brands are approved, as equal to those specified as far as the requirements of the project are concerned.
6. If the bidders do not elect to obtain prior approval during the time so specified above, the Owner/Architect/Engineer or Lighting Designer has no obligation to review or consider any such article after the contract award.
7. Contractor shall pay professional fees at current standard hourly rates and reimburse expenses directly to all designers (Architect, Engineer and Lighting Designer) for time spent reviewing substitutions proposed by the Contractor after the bid has been awarded. If payment by the Contractor is not made within 60 days of invoice date, the Owner shall deduct the amount due from subsequent payments to the Contractor in order to reimburse designers.
8. Request for approval shall be accompanied by working fixture samples (with an appropriate lamp, complete photometric, mechanical and electrical data, list of materials and finishes and unit cost to the Owner) of both the specified brand and the proposed substitutes as required to make complete comparison and evaluation. These samples shall be in addition to those required by Lighting Fixture Specification. The above data shall be delivered separately to the Architect and the Engineer. The fixture samples shall be furnished and installed at the bidder’s expense, at a location selected by the Architect. In addition, the bidder shall furnish the Architect and the Engineer with the name and location of at least one completed project where each proposed substitute has been in operation for a period of at least six (6) months, as well as the names and addresses of the Owner, the Architect and the Engineer.
9. Point by point lighting calculations of areas affected by proposed substitution will be done by the bidder for review.
10. The Architect and Engineer shall determine whether the prototype sample complies with the specifications and shall reserve the right to disqualify any bidders.
11. When required and requested by the Architect, or Engineer, samples submitted as per above shall be subjected to photometric, thermal, mechanical, electrical or water testing at an independent test laboratory at no expense to the Owner.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of lighting fixtures of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience on projects with lighting fixture work similar to that required for this project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 225, 250, 410, and 500 as applicable to installation and construction of building lighting fixtures.
2. NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub/No's LE 1 and LE 2 pertaining to lighting equipment.
3. IES Compliance: Comply with IES RP-1 pertaining to office lighting practices and RP-15, regarding selection of illuminance values for interior office lighting. Comply with IES RP-8, 19, 20, and PB-15 pertaining to exterior, parking, and roadway lighting practices and fixtures.
4. UL Compliance: Comply with UL standards, including UL 486A and 486B, pertaining to lighting fixtures. Provide lighting fixtures and components which are UL-listed and labeled.

D. Special Listing and Labeling: Provide fixture for damp locations, wet locations, recessed in rated ceilings and walls, hazardous that are UL listed and labeled for specific use. Fixtures mounted with air plenum spaces shall be rated for such conditions.

E. Materials and Equipment:

1. Materials, equipment, and appurtenances as well as workmanship provided under this Section shall conform to the highest commercial standards, and as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicated shall be made of materials most appropriate to their use or function and as such resistant to corrosion and thermal and mechanical stresses encountered in the normal application and function of the fixtures.
2. All fixtures shall be manufactured to a consistent level of quality. Size, color, and component parts shall be identical for all fixtures of the same type.
3. Provide lighting fixtures whose performance under specified conditions is certified by the manufacturer.
4. Provide lighting fixtures, ballasts, and lamps produced by a manufacturer listed as an Approved Manufacturer in this section, or noted on the drawings.

1.5 DELIVERY, STORAGE, HANDLING, AND WARRANTY

A. Deliver lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.

B. Store lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperature, humidity, laid flat and blocking off ground.

C. Handle lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

D. Provide a 5-year warranty of failure in materials, workmanship, ballast, etc., in addition to and not limited to other rights the Owner may have under the contract documents. A full warranty shall apply for the first year, and a prorated warranty for the last four years.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways to properly interface installation of lighting fixtures with ceiling requirements.

B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Set screws shall be heavy and of exact bore to fit the stems. Canopy and other set screws shall be large with a bearing of not less than four (4) full threads. All screws in all parts of fixtures shall be brass and of ample and approved size and strength for the purpose intended.

B. All glassware called for on the Drawings shall be furnished and put in place under this Division. Contractor shall be solely responsible for all glassware furnished by him, until the work has been accepted, and he shall leave the work with all glassware in perfect condition and thoroughly clean. Glassware shall be Opal, Carrara, Alba, Corning, Holophane.

2.2 MANUFACTURERS

A. The Contractor shall base bid for lighting fixtures on the manufacturers listed on the fixture schedule only.

B. Alternate manufacturer's identification by means of manufacturer's names is to establish basic features and performance standards. Alternate manufacturer's or substitutions must meet or exceed the standards of the primary manufacturer listed.

C. Qualifications: The contractor is allowed 60 days after the contract has been awarded to submit independent photometric tests and samples for all alternate fixtures. If these fixtures fail to comply with the specification requirements at that time, the Contractor will furnish acceptable fixtures at no additional cost to the Owner and with no delay to the project.

D. Any submittals for cost reduction alternates or value engineering shall include unit prices for the specified manufacturer, the specified equal manufacturer, and the proposed alternates. Refer to Part 1.3 for approval process.

2.3 MATERIALS AND FABRICATION

A. Provide thickness of metal required or as specified so that all fixture are rigid, stable and will resist deflection, twisting, warping or bending under normal installation procedures, loading, relamping, etc.

B. Provide neoprene or silicone gasketing, stops, and barriers where required to prevent light leak or water and water vapor (penetration).

C. Provide finished product with ground metal edges, tight fitting connections, hinges and closures; clean, neat edges, trims, and frames; continuous welds, ground smooth with sharp corners; all exposed screws countersunk flush.

D. Provide positive, durable means of connection at all joints as required.

E. All cast parts, including die-cast members, shall be of uniform quality, free from blow holes, pores, hard spots, shrinkage defects, cracks or other imperfections that affect strength and appearance or are indicative of inferior metals or alloys.

F. Provide sufficient ventilation for lamps, ballasts and transformers including vent holes where required. Outdoor fixtures shall have corrosion resistant wire mesh screens in the vent holes.

G. All adjustable fixtures shall be provided with reliable locking device to secure aiming angles of the fixture housing or lamp yoke as well as lamp and lens orientation devices to secure oval beam pattern lamps and/or spread lenses.

2.4 FINISHES

A. Fixture finishes shall be applied in a manner that will assure a durable, wear resistant surface.

1. Prior to finishing, all surfaces shall be free from foreign materials such as dirt, rust, oil, polishing compounds and mold release agents.
2. Where necessary, surfaces shall be hot cleaned by accepted chemical means and shall receive corrosion inhibiting (phosphating) treatment assuring positive paint adhesion.
3. Provide all ferrous metal surfaces with a protective finish having rest-inhibiting properties. Painted finishes shall be a minimum of 1.5 mils thick and shall have a balance between hardness and bending properties suitable for application. White finishes shall have 87 percent minimum reflectance. Application and cleaning shall be performed so as to prevent any loss of reflectance capability.
4. Finish shall be porcelain or baked enamel, matte white on interiors with minimum tested reflectance of 86%. Manufacturer's standard finish or as specified on plans, on visible exteriors. Base metal shall be thoroughly cleaned and given bonderizing or other approved highly adhesive prime coating. All reflectors shall be of 20 gauge sheet steel with polymerized baked white coating with a reflectance ranging form 85% to 88%.

2.5 WIRING

A. All wiring shall comply with the following:

1. All wiring devices within lighting fixtures or from the fixture to the splice with the project branch circuit wiring shall be as specified below.
2. Wiring shall be protected with tape or tubing at all points where abrasion may occur.
3. Wiring shall be concealed within the fixture construction except where design or mounting dictates otherwise.
4. Connections of wires to terminals of lampholders and other accessories shall be made in a neat and workmanlike manner and electrically and mechanically secure with no protruding or loose strands. The number of wires extending to or from the terminals of a lampholder or other accessory shall not exceed the number which the accessory is designed to accommodate.
5. Individual fixture wiring shall be not less than #16 gauge and shall be limited to insulations with rated maximum operating temperature of 150°C or higher.
6. Where branch circuit wiring calls for two-level lighting, three-and- four-lamp fixtures shall be circuited in a manner so that outer lamps can be switched separately from inner lamp(s), unless otherwise indicated on Drawings.
7. Joints in wiring within lighting fixtures and connections of the fixture wiring to the wiring of the building shall be specified in Division 26.
8. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout, and all points or edges over which conductors must pass and may be subject to injury or wear shall be rounded and bushed.
9. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.
10. Junction boxes attached to lighting fixtures shall be manufactured in accordance with the National Electrical Code and approved for the number of conductors indicated on the

drawings. Supplementary junction boxes shall be installed where required to comply with Code.

11. When exposed, all junction boxes and conduit to be painted as per the Architects' direction at no additional cost to the Owner.
12. Cord types shall be suitable for application and be fitted with proper strain relief and watertight entries where required by application.
13. Furnish code approved wiring in ceiling cavities forming air plenums.

2.6 MARKING OF FIXTURES

A. Fixtures designed for voltages other than 110-125 volts shall be marked with operating voltage.

B. Fixtures equipped for operation of rapid start lamps shall be clearly marked "USE RAPID START LAMPS ONLY."

C. Fixtures designed for operation of lamps below the rated enclosure maximum shall be clearly marked "Lamp Watts Not to Exceed _____" to maintain the design energy load.

D. Where catalog numbers are listed, they shall be considered only as a guide. Contractor is cautioned to take care that where fixtures are ordered by catalog numbers these fixtures must incorporate all the general and particular requirements mentioned in the specification, even though it may be necessary to modify the manufacturer's standard fixture corresponding to the designated type or catalog number.

2.7 SOUND TRANSMISSION

Sound transmission through the light fixture units, when spaced as indicated on drawings, shall be sufficiently attenuated to maintain speech privacy between adjoining spaces. Contractor to provide insulating battens around the fixtures where voice and sound transmission levels are unacceptable.

2.8 THERMAL PROTECTORS

A. Provide thermal protectors as required by the N.E.C., or as required by local Code, to prevent operation of lighting fixtures in enclosed spaces or adjacent to combustible materials at temperatures at or above 90ºC (194ºF).

B. Fixtures approved for operation in fire-resistant material at temperatures up to 150ºC (302ºF) shall be plainly marked.

2.9 LAMPS

A. Provide lamps as shown in the fixture schedule or as modified in reviewed shop drawings.

B. Lamps as specified for the individual luminaries or lighting equipment shall be delivered and installed in fixtures and lighting equipment leaving these completely lamped and in normal operating condition.

C. LED lamp sources shall conform with the IESNA LM-79 and LM-80 published standards. They shall have a color temperature binning that does not exceed +/-200K. LED Lamp life shall be

rated at 70% of initial lumens remaining. LED drivers shall be used @ 100% output for lumen output rating and not be underdriven or overdriven.

D. Lamps shall be by the same manufacturer and produced by the following acceptable manufacturers:

1. General Electric Lighting
2. Osram Sylvania, Inc.
3. North American Philips Lighting
4. Venture Lighting International, Inc.
5. Others only where specified.

E. LED Lamps

1. All LED light fixtures shall conform with the IESNA LM-79 and LM-80 published standards.
2. Initial delivered lumens – thermal losses should be less than 10% when operated at a steady state at an average ambient operating temperature of 25°C, and optical losses should be less than 15%.
3. Average Delivered Lumens – Average delivered lumens over 50,000 hours should be minimum of 85% of initial delivered lumens.
4. LED boards, drivers and associated components shall have a Warranty of 5 years on the LEDs, 5 years on the driver, 10 years on the paint finish.
5. Driver Specification shall include:
   a. Electronic
      Voltage range of (120-277) +/- 10%
      1) Current .35 Add (+/- 5%)
      2) Frequency 50/60 Hz
      3) Power Factor >90% at full load
      4) THD <20% at full load
      5) Load regulation: +/- 1% from no load to full load
      6) Output ripple <10%
      7) Output should be isolated
      8) Case temperature: rated for -40º through +80 º
      9) Overheat protection, self-limited short circuit protection and overload protected

10) Primary fused
11) Life rating not less than 50,000 hours

2.10 LAMPHOLDERS

A. Lamp sockets shall be rigidly attached to fixture enclosure or husk.

B. Plastic or metal sheet sockets are not to be used.

C. All lamp sockets shall be suitable for the indicated lamps and shall be set so that lamps are positioned in optically correct relation to all lighting fixture components. All adjustable sockets shall be preset at the factory for lamp specified.

2.11 REFLECTORS

A. All reflectors shall be of glass or metal of the type required by the drawings and of the size recommended by the manufacturer for the lamp rating indicated. In all cases, holders shall be made so as to support the reflector in proper relation to the lamp filament

B. Reflectors and reflecting cones or baffles shall be as follows:

1. Absolutely free of any tooling marks including spinning lines, indentations caused by riveting or other assembly techniques.
2. No rivets, springs, or other hardware visible after installation.
3. First quality polished, buffed and anodized finish, “Alzak” or approved equal.
4. Specular finish color as selected by the Architect or as specified in the fixture schedule.

C. Other aluminum reflectors shall be as follows:

1. Formed and finished as noted on the Drawings and elsewhere in the Specification.
2. Reflectors free from blemishes, scratches, or indentations which would distort their reflective function.
3. Finished by means of the “Alzak” process or approved equal unless otherwise noted.

D. Reflector and housing shall comply completely enclose the fixture’s lamp in downlights in a plenum ceiling and provide the full rated output of the lamp. Fixtures that vent through the downlight reflector into the plenum are not acceptable.

2.12 LENSES AND DIFFUSERS

A. All lenses secured by positive means with neoprene or silicone gasketing or washers as required to hold the lens tight within a frame or attach to a housing.

B. All glass lenses shall be heat treated (tempered) or sealed with a clear acrylic laminate layer to provide a “safety glass” rating. All lenses which require removal for relamping or normal maintenance shall be attached to the fixture housing by a minimal length of safety chain to prohibit the lens from falling and striking surrounding surfaces.

C. Acrylic lenses shall be 100 percent virgin acrylic polymer and colorless and shall be guaranteed for 15 years against crazing or warping. Lens shall be (.156”) thick.

D. The quality of the raw acrylic material must exceed IES, SPI, and NEMA Specifications by at least 100 percent which, as a minimum standard, shall not exceed yellowness factor of 3 after 2,000 hours of exposure in the Fade-o-meter or as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 15 years.

E. All plastic diffusers shall be given an approved destaticizing treatment prior to installation, and instructions shall be left with Owner for similar destaticizing after cleaning. Diffusers must be put up with no finger or dirt-marks. Use white gloves, if necessary.

2.13 LOUVERS

A. All louvers shall be fabricated of the specified material.

B. Louver finishes shall be provided as specified.

C. All plastic parabolic louvers shall be destaticized before and after fabrication to insure minimum maintenance.

D. All metal louvers shall be coated with anti-rust material and electrostatically painted.

E. All louvers shall be heat tested to withstand lamp operating temperatures with no deformation of shape, paint blistering or discoloration.

2.14 FIXTURE TRIMS

A. Fixtures shall have finish trim designed for the following types of ceiling systems: Ceiling Type Trim Type
   1. Recessed Fixtures
      a. Plaster - Overlap Trim.
      b. Concrete - Overlap Trim.
      c. Tile - Overlap Trim.
      d. Gypsum - Overlap Trim.
      e. Metal Pan, Concealed M - Modular, Fit-in Support.
      f. Lay-in - Modular, Tile with Flush Fit-in.

B. Provide trim details as shown on the Drawings or as specified, which are indicative of appearance and dimensional requirements. The trim finish and dimensions subject to the approval of the Architect.

C. Trimless fixtures shall be installed per manufacturer’s guidelines and shall be installed and coordinated with other trades as required.

D. Mitered corners shall be continuously welded and smoothed before shop finish is applied. No lapping of trim metal for all flush mounted ceiling trims for rectangular or square recessed fixtures.

E. Provide a mounting frame or ring with lock recessed or semi-recessed light fixture to secure the mounting frame to the ceiling and support any reflectors, trims, or lenses. Ring shall be

compatible with the ceiling and of sufficient strength to rigidly support the fixture and any stress applied in relamping.

F. Catalog numbers are included for reference. Provide all accessories and design features described herein regardless of whether such features are included in catalog reference including, mounting hardware, louvers, lenses, filters, transformers, etc.

2.15 LIGHTING FIXTURE TYPES AND CATALOG NUMBERS

A. General: Various fixtures types required are indicated on drawings fixture schedule. Fixtures must comply with minimum requirements as stated herein. Review architectural drawings and specifications to verify ceiling types, modules, suspension systems appropriate to installation.

2.16 SUPPORTS FOR SUSPENDED FIXTURES

A. Provide separate and isolated suspension for all fixtures required by the Local Building Department and seismic requirements. This may include rod hangers, hook hangers, or single stem hangers.

2.17 EMERGENCY LIGHTING UNITS

A. All Exit signs shall be pr complete with mounting hardware directional chevrons, mirrored backing and graphics. Single face exit signs shall be constructed to they can read from either side.

B. Exit signs shall be edge-lit with faces and directional arrows per plans.

C. All single-face edge-lit exit lights shall have a mirrored backing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate for supporting lighting fixtures. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION OF LIGHTING FIXTURES

A. Contractor to coordinate exact quantities and critical dimension with field conditions.

B. Contractor to verify and coordinate that appropriate framing, support structures, mounting brackets, and other required structural connections are provided by the General Contractor or other trades to insure a timely, neat installation of all luminaries.

C. Contractor to coordinate and provide any associated mounting hardware, conduit connections, or associated appurtenances to effectively install the luminaries. Provide each light fixture with complete installation instructions. All light fixtures to be installed in strict conformance with manufacturer’s recommendations and instructions.

D. Coordinate space conditions with other trades.

E. In Mechanical Equipment Room modify locations and mounting to suit conditions as directed. Electrical contractor must coordinate fixture location with mechanical equipment room layout or wait until mechanical equipment is installed

F. Install lighting fixtures in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

G. Exact locations of all lighting fixtures including mounting heights and plan dimensions are as per the Architectural Drawings. Any ambiguities or conflicts in this dimensional information to be identified to the Architect prior to installation.

H. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight. Submit design of hangers, method of fastening, other than specified herein, for review by Architect.

I. Install flush mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.

J. Provide plaster frames for recessed fixtures installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

K. Fasten fixtures securely to structural supports, and ensure that pendant fixtures are plumb and level. Provide individually mounted pendant fixtures longer than 2 feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum on inch vertical adjustment. Mount continuous rows of fixtures with an additional stem hanger greater than number of fixtures in the row.

L. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified on UL Stds. 486A and 486B and the National Electrical Code.

M. Support pendant mounted fixtures greater than an overall 2 feet in length at a point in addition to the outlet box fixtures stud with an appropriate safety cable. Certain decorative pendant fixtures may not require a safety cable, verify with Architect, Engineer or Lighting Designer.

N. Fasten electrical lighting fixtures and brackets securely to indicate structural supports, including poles/standards, and ensure that installed fixtures are plum and level.

O. Rigidly align all continuous rows of fixtures for true in-line appearance.

P. Do not install exposed fixtures, reflectors or trims until all plastering and painting that may mar fixture finish is completed. Replace blemished, dented, damaged or unsatisfactory fixtures as directed.

Q. Support all fixtures independent of ductwork or piping.

R. Install rows of fixtures in straight lines, except as noted. Install fixtures so that fixture doors open from same side.

S. Pendant mount fixtures where indicated, and provide all mounting hardware.

T. Mount fixtures in accordance with manufacturer's installation details and applicable codes. Provide all required accessories.

U. Install reflector cones, baffles, aperture plates, and decorative elements after completion of ceiling tiles, painting and general clean-up.

3.3 FIELD QUALITY CONTROL

A. Replace defective and burned out lamps for 3 months following the Date of Substantial Completion.

B. At Date of Substantial Completion, replace lamps in lighting fixtures which have been operational over 400 hours and have a lamp life of less than 4,000 hours.

1. Refer to Division-1 sections for the replacement/restoration of lamps in lighting fixtures, where used for temporary lighting prior to Date of Substantial Completion.

C. Furnish stock or replacement lamps amounting to 5%, but not less than 4 lamps in each case, of each type and size lamp used in each type fixture. Deliver replacement stock as directed to Owner’s storage space.

D. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

E. Certify that the equipment has been properly installed, adjusted, and tested.

F. For sloped ceilings:

1. Provide sloped ceiling adapters for all fixtures in sloped ceilings.

2. Contractor shall coordinate with architectural details for degrees of slopes, mounting details, etc.

3.4 CLEANUP

A. Clean lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses. Two weeks prior to substantial completion, re-clean all fixtures for dust, fingerprints, smudges from all visible parts of the fixture.

B. Protect installed fixtures from damage during remainder of construction period.

C. At the time of final acceptance by the Owner, all lighting fixtures shall have been thoroughly cleaned with materials and methods recommended by the manufacturers, all broken parts shall have been replaced, and al lamps shall be operative.

3.5 GROUNDING

A. Provide equipment grounding connections for lighting fixtures as indicated by branch circuitry. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.6 DEMONSTRATION

A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

1.1 GROUNDING

A. Provide equipment grounding connections as indicated herein. Tighten connection to comply with torque tightening requirements specified in UL Standard 486A to assure permanent and effective grounds.

B. Refer to Section 26 05 26 for additional grounding requirements.

1.2 FIELD QUALITY CONTROL

Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, “Acceptance Testing Specifications for Electrical Power Distribution Equipment”.

A. Infrared Inspection (After Energized)
   1. The scan is to include all electrical panelboards or bussed distribution equipment.
   2. All equipment should be energized at normal load levels during an event for at least 1 to 2 hours prior to being scanned.
   3. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.
   4. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
   5. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

B. Panelboards:
   1. Visual and Mechanical Inspection:
      a. Inspect for physical damage and code violations.
      b. Inspect for proper alignment, anchorage and grounding.
      c. Inspect for proper identification of protective devices and switches.
      d. Check tightness of accessible bolted buss joints.
      e. Physically test all electrical or mechanical interlocks to assure proper function.
      f. Clean interior and insulator surfaces once a month prior to job completion.
      g. Inspect for proper operation of space heaters and thermostat settings (if they exist).

2. Electrical Tests:
   a. Measure insulation resistance of each buss section phase-to-phase and phase-to-ground.
   b. Check panelboards for electrical continuity of circuits and for short circuits.

1.3 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

1.4 DEMONSTRATION

A. Subsequent to wire and cable hook-ups, energize and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 265100

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections.

B. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

C. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

D. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. The term “provide” used throughout this specification and drawings shall mean “furnish, install, test, and certify”.

B. Coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Construction Manager and/or General Contractor and all necessary trades to ensure successful completion of work.

C. Phasing, temporary distribution/equipment, cut-over and implementation shall be coordinated with Owner, Construction Manager and/or General Contractor, Architect, and Engineer.

D. Extent of communications infrastructure work is indicated by Division 27 specifications and Technology drawings and schedules and is hereby defined to include, but not by way of limitation, the provisions of:

1. Raceway systems including but not limited to conduits, cable trays, sleeves, surface raceways, pull-boxes, junction boxes, back-boxes, etc. as required and specified in Division 27 sections and/or select Division 26 sections. The Construction Manager and/or General Contractor shall coordinate this with the Sub-Contractor performing work and determine how scope of work is assigned. The purpose of this specification is to establish design intent and general system scope.
2. All communications infrastructure shall be provided as part of this project including but not limited to raceway, cable, cable terminals, and comm room fit-out.
3. Horizontal or station cables between each communication device outlet and the nearest Intermediate Cross-connect (IC) location.
4. Horizontal cable termination and terminals including but not limited to wiring panels/blocks, patch panels, fiber optic terminals and panels, and outlets/jacks.
5. Patch cords, jumper cables, and cross-connect cables to interconnect wiring terminals as well as electronic equipment.
6. All physical cable management hardware including, but not limited to: “J-hooks” in accessible ceiling areas, “D-rings” on backboards, vertical and horizontal managers on racks and cabinets, vertical and horizontal ladder-type or wire basket cable tray within communication rooms, etc.
7. Fire stopping as required. Contractor shall provide fire stopping for all low-voltage openings (including empty low voltage raceway) once cable installation is complete.

Confirm specific fire stopping scope requirements with General Contractor and/or Construction Manager.

8. Seismic bracing of all equipment cabinets, equipment racks and ladder-type or wire basket cable tray as required by code and by local governing jurisdiction.
9. Testing of all communications cable infrastructure and grounding systems as noted by specification, drawings, and applicable industry standards.
10. Labeling of all communication infrastructure components, hardware, cable, and terminations with mechanically printed labels.
11. Preparation and submission of product data, shop drawings, testing reports, as-built drawings, and cabling documentation as required in this specification.
12. Construction and Installation warranties.
13. Manufacturer components, channel and solutions warranties.
14. Installation and testing of all system and components.
15. Manufacturer training of components.

1.2 SUBMITTALS

A. General Description and Requirements

1. Submittal Schedule:
   a. Within two weeks after award of contract, the Contractor shall submit a proposed schedule for submitting product data and shop drawings. At a minimum, the following items shall be included:
      1) Submittal date for Construction Schedule.
      2) Submittal date for Product Data.
      3) Submittal date for Shop Drawings.
      4) Submittal date for Commissioning and/or Test Results.
      5) Submittal date for As-Builts.
   b. Within 45 days after award of contract or as dictated by the construction schedule (whichever period of time is shorter), the Contractor shall submit prefabrication submittals consisting of product data and shop drawings for approval. Partial submittals will not be accepted without prior written approval from the Architect.
2. In addition to the requirements noted herein, refer to Division 1 Specification for additional requirements. As a minimum, Contractor shall ensure all requirements listed here are met.
3. Review of the Prefabrication Submittals by the Architect is for purposes of tracking the work and contract administration and does not relieve the Contractor of responsibility for any deviation from the Contract Documents, or from providing equipment and/or services required by the Contract Documents which were omitted from the prefabrication submittals.
4. No portion of the project shall commence nor shall any equipment be procured until the prefabrication submittals have been approved in writing by the Architect. All installations shall be in accordance with the Contract Documents.
5. A detailed completion schedule shall be submitted with the prefabrication submittals.
6. Prefabrication submittals shall be accompanied by a letter of transmittal identifying the name of the project, Contractor's name, date submitted for review, and a list of items transmitted.

B. Product Data:

1. Warranty Information: Provide all warranty information as described in this specification section for review and approval.
2. Component List: Provide complete submittal component list (i.e. table of contents) at the beginning of the submittal package. Component list shall include:
   a. Component name
   b. Manufacturer

c. Specific product number (to clearly indicate special options, colors, etc.)

3. Cut-Sheets: Submit manufacturer's cut-sheets on all components listed within this specification. All components and parts being used shall be highlighted in color on cut-sheets to distinguish specific product/part numbers, options, colors, accessories, etc.
4. Product Substitutions: The Contractor may submit (as a proposed alternate solution) substitute manufacturers and models that may be more cost effective or readily available. All substitutions shall meet or exceed the minimum functional, physical, and technical specifications. Acceptance of such substitutions is at the discretion of the Owner, Architect, and Engineer. Additionally, the requirements of Division 1 Specifications shall apply and may supersede requirements noted herein.

C. Prefabrication Shop Drawings:

1. Symbol Legend, Abbreviations, and Description: Provide drawings including descriptions of all abbreviations, symbols, typical mounting heights, project information, etc.
2. Floor Plans: Indicating all communication device outlets, equipment, and components proposed to be installed. Floor plans shall indicate cable routing origin and labeling scheme for each cable and termination position. Refer to Division 26 "Wiring Devices" specification for additional requirements for floor boxes. Additionally, major raceway routing shall be indicated for cable trays and conduits 2-inches and larger, based on final coordination with all other trades. Shop drawings shall clearly indicate areas with cable tray clearance limitations and/or other cable access limitations for review and approval by Owner, Architect, and Engineer.
3. Enlarged Plans: Provide ¼" = 1'-0" enlarged plans of all communication rooms (as
4. Drawing Scale: Shop drawings shall be drawn to scale and completely dimensioned as to clearly show construction detail.
5. Labeling: Provide documentation of all labeling schemes for conduit, back-boxes, cables, outlets, wiring blocks and/or patch panels, device faceplates, etc.
6. Documentation: Provide a minimum of (1) hardcopy set of prints (in addition to electronic copies) for review or as indicated in Division-1 general conditions.

1.3 QUALITY ASSURANCE

A. Codes and Standards: All materials and installations shall comply with current applicable codes and standards, including but not limited to:

1. ANSI/EIA/TIA-526: Standard Test Procedures for Fiber Optic Systems.
2. ANSI/EIA/TIA-568-C.0: Generic Communications Cabling for Customer Premises.
3. ANSI/EIA/TIA-568-C.1: Commercial Building Communications Cabling Standards, Part 1: General Requirements.
4. ANSI/EIA/TIA-568-C.2: Balanced Twisted-Pair Communications Cabling and Components Standard.
5. ANSI/EIA/TIA-568-C.3: Optical Fiber Cabling Components Standard.
6. ANSI/EIA/TIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces.
7. ANSI/EIA/TIA-606-A: Administrative Standard for Commercial Telecommunications.
8. ANSI/J-STD-607-A: Commercial Building Grounding and Bonding Requirements for Communications.
9. TIA-758-A: Customer-Owned Outside Plant Communications Cabling Standard.
10. ANSI/TIA-942: Telecommunications Infrastructure Standard for Data Centers.
11. ASTM: American Society for Testing and Materials
12. BICSI CO-OSP Design Manual (current edition): Customer-Owned Outside-Plant Design Manual.

13. BICSI Electronic Safety and Security (ESS) Design Reference Manual (current edition).
14. BICSI Network Design Reference Manual (current edition).
15. BICSI TDM Telecommunications Distribution Methods Manual (current edition).
16. BICSI Wireless Design Reference Manual (current).
17. EIA/TIA TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling.
18. ICEA: Insulated Cable Engineers Association
19. IEEE-802.11 a, b, g, n: Wireless Local Area Networks
20. IEEE-802.3: 10Mb/s, 100Mb/s, 1Gb/s, and 10Gb/s Ethernet Standards as applicable based on media types (twisted pair copper, fiber optics, etc.)
21. IEEE-802.3ak: 10Gb/s Ethernet (evolving copper standard).
22. IEEE-802.3af: Power-over-Ethernet (PoE).
23. IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
24. IEEE-241: Recommended Practice for Electric Power Systems in Commercial Buildings.
25. ISO/IEC 11801: International Standard on Information Technology – Generic Cabling of Customer Premises.
26. NESC: National Electrical Safety Code
27. NEMA Stds Pub No. VE 1, Cable Tray Systems. Additionally, comply with current edition of NEC, as applicable to construction and installation of cable tray systems.
28. NEMA Std 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
29. NFPA-70/NEC: National Electrical Code.
30. NFPA-72: National Fire Alarm and Signaling Code
31. UL Compliance: Provide products which are UL-listed and labeled.

B. Manufacturer and Product Qualifications

1. Provide products from manufacturers regularly engaged in the production of communications infrastructure components, including but not limited to, raceway, horizontal copper cabling, copper and fiber optic backbone cabling, and connecting hardware.
2. Provide products from manufacturers whose products of similar types, capacities, and characteristics have been in satisfactory use in similar type projects for not less than five years.

C. Contractor Qualifications:

1. Firms with at least seven (7) years of successful installation experience with projects utilizing communications structured cabling, media systems, infrastructure, raceway and equipment similar to that required for this project.
2. The company shall have a fully staffed office with technical installations support personnel within 30 miles of the project. (Exceptions to this shall be confirmed through approval by the Owner, Architect, Contractor, and Engineer.)
3. The Low Voltage Raceway Contractor shall be a certified installer (current and in good standing with proven history) of the selected manufacturer's raceway systems and shall provide a 25-year warranty on installation and applications.
4. The Low Voltage Cabling Contractor shall be a certified installer (current and in good standing with proven history) of the selected manufacturer's structured cabling systems, and shall provide a 25-year warranty on structured cabling installation and applications.
5. The company shall have a BICSI RCDD on staff.

D. All materials shall be Underwriters Laboratories (UL) or Intertek Testing Services (ETL) Listed unless otherwise indicated.

E. Coordinate with local telephone company for primary and diverse service to Telecommunications Demarcation location(s) within the facility.

F. Coordinate with electrical work and other trades to properly interface installation of telephone system with other work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.

B. Store equipment and components in original packaging. Store inside in a well-ventilated space protected from weather, moisture, soiling, humidity, and extreme temperatures.

C. Handle equipment and components carefully to prevent damage. Do not install damaged units or components; replace with new.

1.5 SEQUENCING AND SCHEDULING

A. All work shall be reviewed and coordinated with the Construction Manager and/or General Contractor prior to commencing.

B. Communication systems, infrastructure, raceway and equipment are sensitive to environmental conditions including but not limited to temperature, dirt, dust, and water. The contractor shall ensure the storage and installation of all communication components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty void of such systems. All mis-installed components shall be replaced with new parts and re-installed at the Contractor's expense.

C. Coordinate installation with Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.

D. Sequence installation of communications systems and infrastructure with other work to minimize possibility of damage and soiling during remainder of construction.

1.6 PROJECT SITE CONDITIONS

A. Prior to submitting a proposal, the Contractor shall inspect the Contract Documents, and shall become fully informed as to laws, ordinances, and regulations affecting the project. The Contractor shall immediately bring to the Owner, Architect, and Engineer's attention, in writing, any existing condition or statute that contradicts, is in conflict with, or negates the Contract Documents. Failure of the Contractor to become fully informed as to all above mentioned items shall in no way relieve the Contractor from any obligations with respect to their proposal.

B. The Technology Drawings depict equipment locations, backboxes, conduit runs, cabling, etc. in a schematic manner. Field conditions and coordination with related trades may warrant relocations of field devices. No additional compensation will be allowed due to these revisions.

1.7 WARRANTY

A. The manufacturer shall provide a warranty with a minimum term of 25-years for structured cabling and all communications cable infrastructure components. This warranty shall cover all components including cables, jacks, patch panels, and wiring panels, etc. to maintain the specified performance, physical criteria, and applications assurance. Any such components, link, or channel shall be replaced by the Manufacturer at no cost to Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

B. A one (1) year warranty on the Work shall be provided by the Contractor. If, within one (1) year after the date of final acceptance of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified, either verbally or in writing.

C. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents or any manufacturer's warranty. The establishment of the time period noted above, after the date of final acceptance or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents, relates only to the specific obligation of the Contractor to correct the work or equipment, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the work or equipment.

D. If system operation is not fully restored during the warranty period within two (2) business days, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

E. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment of system being expanded.

1.8 SPECIFICATION RESPONSE

A. Pricing

1. Instructions to Bidders
   a. The following is a partial list of instructions. Bidders are responsible to provide a complete proposal inclusive of all information requested in the Contract Documents.
   b. Do not assume anything. Clarify your position in writing with your bid concerning any areas that may not be clear to you.
   c. Copies of the bid proposal shall be submitted to the Owner, Architect, and Engineer for review and approval.

d. Bidders shall prepare equipment lists showing each item included in the bid. Equipment Lists must include the quantity, model number, manufacturer and price of each item listed under the generic description.
e. Provide a detailed description of any and all voluntary alternates and include cost changes in the Voluntary Alternate Bid forms. Bidders should submit voluntary alternates that will either provide for a better system or reduce costs without degrading the system. This includes alternate manufacturer and product substitution.
f. In the instance where the Drawings and the Specifications do not directly coincide, or coincide individually, the item of better quality, greater quantity and/or higher cost shall be included in the base bid.

B. Compliance

1. Bidders shall submit a Statement of Qualifications with their bid proposal that shall include the following information:
   a. Company name, address, telephone number and contact person.
   b. Brief company history.
   c. Resumes of key personnel.
   d. Local staffing description (job descriptions and numbers of persons in each position).
   e. Local service capabilities (hours of operation and parts availability).
   f. Technician factory certifications.
   g. Description of local engineering and project management capabilities.
   h. Line sheet listing major suppliers of security equipment.
   i. Annual dollar value of sales, installation and service of each product line carried.
   j. List of references describing three (3) completed projects of similar size and complexity, including names and telephone numbers of the contact persons.
   k. List of references describing similar projects completed in the area including names and telephone number of the customer's contact person.
   l. List of similar projects currently under construction in the area including names and telephone numbers of the customer's contact person.
   m. Licensing information.
2. Additionally, as described in this Specification, bidders shall submit the following information with their bid proposal:
   a. Manufacturer's literature sheets for all standard manufactured items included in the equipment list and as proposed in the Voluntary Alternate Bid form, if applicable.
   b. Workload and capability statements. The statements shall detail projects that will be active during the completion of this project, and the manpower that would be available for this project.
   c. Confidentiality and return statements. The statements shall guarantee that the Contract Documents shall not be copied or distributed physically or verbally. The Contractor shall also assure the Owner that the Contract Documents shall be returned in their entirety upon request. The successful Contractor will be provided with as many copies as requested.
   d. Copy of manufacturer’s certification certificate.
3. Certain paragraphs of the Specification require the Bidder to provide information (possibly not listed above) in the proposal to demonstrate compliance with a requirement. If the Bidder fails to provide detailed responses to these items, the proposal will be deemed to be non-compliant to the paragraphs stated.
4. Number all pages of the bid submittal.

1.9 DEFINITIONS

A. Acronyms and Definitions

1. Refer to Technology Symbol Legend and Abbreviations shown on drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Refer to each of the specification sections listed below for requirements:

1. 27 15 00: Communications Horizontal Cabling

B. All equipment shall be reviewed with WMC Information Systems, Telecommunications, Biomed and Security groups prior to purchase.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General:

1. The Contractor shall comply with all project expectations and submittal requirements as indicated in Part 1 of this specification. This includes initiating a “CA kickoff” meeting to discuss general project expectations with the project team.
2. Examine areas and conditions under which communications systems and infrastructure are to be installed. Notify Owner, Architect, and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
3. The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.
4. The Contractor is required to coordinate their efforts with the other trades and sub-contractor who may be working within the same vicinity to avoid conflict and lost time.
5. The Contractor shall be responsible for furnishing all materials indicated on the drawings or as specified herein for a complete communications system.
6. The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
7. All communications infrastructure shall be installed in an aesthetically pleasing fashion. All surface raceway in new buildings must be approved by the Owner, Architect, and/or Engineer.
8. All communications infrastructure shall be installed for optimal performance.
9. All communications infrastructure shall be installed to allow for convenient operation, testing, and easy adds, moves, and other changes in the future.
10. All components noted in the drawings and specifications shall be provided and completely setup and installed.
11. The Contractor shall verify space requirements and locations before starting cable installations and terminations. Inappropriate conditions shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation.

12. The contractor shall not install any component in a manner or condition that will void manufacturer and/or contractor warranty. Any such conditions that prevent an acceptable install shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation. All mis-installed components will be removed and replaced with new at the Contractors expense. No additional cost will be submitted to Owner.

C. Communications Raceway Infrastructure:

1. Contractor shall provide conduits through walls and across inaccessible ceiling spaces to ensure unobstructed pathway back to the nearest communications room or cable tray.
2. Provide protective cable bushings on all conduits immediately after installation.
3. Use only electrical 45º or 90º conduit elbows with long bend radii as follows:
   a. 6:1 bend radius of the inside conduit diameter for sizes 2-inches or less.
   b. 10:1 bend radius of the inside conduit diameter for sizes greater than 2-inches.
4. Do not place more than two 90º sweeps or exceed 100 ft. between pull boxes without providing a pull box.
5. Fire-seal all raceway penetrations and openings to maintain fire rating after communications cables are installed.
6. Cable fill in riser conduits shall not exceed 40% cable fill.
7. Where applicable, the Contractor shall verify existing cable fill in riser conduit before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional riser conduit, where additional cables to be added will exceed the 40% cable fill.

D. Communications Cabling Infrastructure:

1. All communications cable routed within communications rooms shall be bundled and combed to provide a neat and organized appearance. Cables shall be bundled using only manufacturer and industry approved Velcro wire ties (zip ties shall not be used) with tensions that do not deform and damage cable resulting in loss of transmission or performance. Any bundles and combing methods used shall not exceed manufacturer or industry standards recommendations for that cable type.
2. Contractor shall provide dedicated J-hooks at 48-inches on-center for all communications cabling not run in conduit or cable tray.
3. The contractor shall not install any cable in conduits that do not have the appropriate protect bushings on conduit ends. All mis-installed cable will be removed, bushings installed, and new cable re-installed at the Contractors expense. No additional cost will be submitted to Owner.
4. Cable bends shall not be greater than that recommended by the manufacturer of the cable.
5. Care shall be taken so as not to damage cable during the installation process and that manufacturer's pull tension specification is not exceeded.
6. Provide a minimum 8'-0" and maximum 10'-0" of slack. Loop at the IC-rooms to be contained on the horizontal cable tray or ladder rack.
7. Provide a minimum of 3'-0" of slack for all device cable termination points. Slack shall be contained in accessible ceiling near the final termination point or in the cable tray nearby when continuous conduit is routed back to cable tray.
8. Within communications rooms, cables shall be snugly wrapped using Velcro reusable cable ties, a minimum of every 3'-0" for cable organization. Velcro ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used anywhere on the project.

3.2 LABELING

A. All communications components shall be clearly labeled using labeling devices (i.e. hand written labels are not acceptable) with white label and black text. All labels shall be consistent font type and size (for respective components).

B. Refer to details in the MEP drawing set for labeling standards.

C. Coordinate labeling with WMC Information Systems, Telecommunications Biomed and Security groups.

END OF SECTION 270500

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections.

B. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

C. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

D. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.3 SUBMITTALS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.4 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.6 SEQUENCING AND SCHEDULING

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.7 PROJECT SITE CONDITIONS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.8 WARRANTY

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.9 SPECIFICATION RESPONSE

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.10 DEFINITIONS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

PART 2 - SYSTEM REQUIREMENTS

2.1 HORIZONTAL STRUCTURED CABLING SYSTEM

A. Topology

1. The Communications Horizontal Cabling will be an industry standard physical star topology with cabling routed to each communication device outlet location from the nearest Horizontal Cross-connect (HC) location, unless noted otherwise.
2. Communications horizontal cabling shall not exceed a total cable length of 295-feet (90m) for the permanent basic link. The channel length shall not exceed 325-feet (100m) when patch cords are installed.
3. Contractor(s) responsible for providing the communications horizontal raceway and/or cabling shall ensure that the pathway and cable to each device location does not exceed 295-feet (90m) length back to the nearest HC location. Contractor shall bring any distance concerns to the attention of the Architect and Engineer during the bid process and/or at a minimum during the shop drawing process, prior to installation.
4. Contractor shall immediately notify Owner and Engineer of any cable segment that exceeds the length limitation.
5. Refer to drawings for additional requirements.

B. General Requirements

1. All cable and terminations shall meet the minimum Performance and Criteria listed in specification below and on drawings.
2. Cable requirements including cable quantities are specified on the drawings.
3. All cables shall have the appropriate fire spread rating per building codes, industry standard, and Underwriters Laboratory (UL/cUL) including plenum (CMP/OFNP/OFCP), riser (CMR/OFNR/OFCR), etc. The contractor shall verify the appropriate cable is being used for application it is installed.
4. Any cable routed outside and/or below grade shall utilize specific water block construction. Cables generally use gel-filled compound to achieve this rating for copper cable and dry water block paper for others. The contractor is required to submit an Outdoor Rated and/or Underground Rated solution wherever this condition exists regardless of whether noted on drawings.
5. Outdoor Rated and/or Underground Rated cable that doesn’t carry a suitable building cable rating per building code and UL, shall not be routed more than 50-ft (15m) inside the building. Cable shall be spliced or terminated as appropriate and noted on drawings.
6. Cabling system shall be procured from a single manufacturer that offers a complete end-to-end certified and warranted system for the ANSI/TIA/EIA-568-C.2 Category noted for each system. Additionally, all products provided shall be the newest products offered by the manufacturer for the product category specified.
7. Cable splices of any kind are not acceptable for communications horizontal cabling system.

C. Performance and Criteria

1. General Horizontal Cabling Requirements:
   a. Cable Rating:
      1) Plenum Rated (CMP).

2) Riser Rated (CMR) or General Rated (CM) when installed in continuous conduits or non-plenum spaces as determined by Authority Having Jurisdiction (AHJ).
3) Outdoor Rated (all outdoor or below grade applications).

b. Cable Construction:
1) Type: Unshielded Twisted Pair.
2) Medium: Solid Annealed Copper.

c. Length Limitations:
1) 295-feet (90m).

d. Physical Specification
1) Standard Cable Sizes: 4-pairs.
2) Conductor Size: 24 AWG.

e. Compliances:
1) ANSI/TIA/EIA-568-C.2,
2) NEC/CEC Type CMP.

f. Electrical Specification
1) Characteristic Impedance: 100 Ohms.
2) Cat.5E Frequency: 1-100 MHz.
3) Cat.6 Frequency: 1-250 MHz.
4) Cat.6A Frequency: 1-500 MHz.

g. Temperature:
1) CMP Operating and storage: -4 to +140F (-10 to +60C)
2) OSP Operating and storage: -40 to 140F (-40 to +60C)

h. Pulling Tensions (max): 25-lb (11 kg).

i. Transmission Performance (min.)
1) Refer to tables below for each applicable cable type.

2.2 CABLE REQUIREMENTS

A. General

1. The cables shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on ANSI/TIA/EIA-568-C.2 equivalent cable rating.
2. Colors:
   a. Device outlets, patch panel termination labels, and patch cords may be colored to differentiate applications types. Horizontal voice/data cables do not require separate colors. Refer to Technology drawings (symbol legend) for additional requirements on color coding.

B. Category 6 Plenum Rated – Horizontal Cable

1. General:
   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6.
2. Application: Primarily for communications horizontal cable installation within duct, conduits or cable trays. May also serve in the building backbone and riser applications.
3. Construction:
   a. Insulation: Flame retardant semi-rigid Fluoropolymer.
   b. Shield/Sheath: None.

c. Filling Compound: None.
d. Jacket: Flame retardant PVC.

C. Category 6 Outdoor Rated – Horizontal Cable

1. General:
   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6.
2. Application: Primarily for communications horizontal cable installation within duct or conduits in outdoor or underground locations.
3. Construction:
   a. Insulation: Polyethylene.
   b. Shield/Sheath: None.
   c. Filling Compound: Yes, water block filling compound.
   d. Jacket: Polyethylene.

D. Category 6e Plenum Rated – Horizontal Cable

1. General:
   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6A.
2. Application: Primarily for communications horizontal cable installation within duct, conduits or cable trays. May also serve in the building backbone and riser applications.
3. Construction:
   a. Insulation: Flame retardant semi-rigid Fluoropolymer.
   b. Shield/Sheath: None.
   c. Filling Compound: None.
   d. Jacket: Flame retardant PVC.

E. Category 6e Outdoor Rated – Horizontal Cable

1. General:
   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6A.
2. Application: Primarily for communications horizontal cable installation within duct or conduits in outdoor or underground locations.
3. Construction:
   a. Insulation: Polyethylene.
   b. Shield/Sheath: None.
   c. Filling Compound: Yes, water block filling compound.
   d. Jacket: Polyethylene.

2.3 TERMINATION REQUIREMENTS

A. General

1. All terminations shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on ANSI/TIA/EIA-568-C.2 equivalent cable rating.
2. All terminations for copper cables located on the face of the building or at remote locations outside of the building footprint (i.e. IP security cameras, WLAN data, etc.) shall

have surge protectors at the termination point within the communications room. Contractor shall comply with manufacturer recommendations.

3. Specific and dedicated patch panels shall be used when multiple ANSI/TIA/EIA-568-C.2 cable categories are used on the same project.
4. Provide all necessary wiring terminals and horizontal cable managers.
5. Provide double-sided horizontal cable manager above and below each patch panels as indicated in 271100.
6. Terminate 4-pairs per RJ45 jack per T568B standard termination. Exact requirements shall be coordinated and approved with Owner, Architect, and Engineer prior to initiating any work.
7. Specific communication device outlet types shall be grouped together on patch panels. Additionally, 20% spare jacks shall be added within each grouping.

B. RJ45-Type Patch Panels

1. RJ45-Type, Ortronics OR-PHA66U48
2. Pin Configuration: T568B.
3. Mounting Configuration: 19-inch EIA Rack.
4. Size: 48-port (provide as required to terminate all cable).
5. Colors:
   a. Patch panel termination labels may require color coding to differentiate applications types. Refer to Technology drawings (symbol legend) for additional requirements on color coding.
6. Cable Interface:
   a. Input: 110-Type (back).
   b. Output: RJ45-Type (front).
7. Electrical Specifications:
   a. ANSI/TIA/EIA-568-C.2:
   b. Insulation Resistance: 500 MegaOhms (minimum).
   c. Current Rating: 1.5A @68 ^{O}F (20 ^{O}C).
   d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
   e. UL and cUL Listed
   f. FCC Part 68.
8. Plug Requirements:
   a. Retention Force: 30-lb (133N).
   b. Insertion Life: 750 minimum.
   c. Plug/Jack Contact Force: 0.22-lb (100g).
9. Temperature
   a. Operating: +14 to +140 ^{O}F (-10 to +60 ^{O}C).
   b. Storage: -40 to +158 ^{O}F (-40 to +70 ^{O}C).
   c.

C. RJ45-Type Device Outlet Jacks

1. Type: RJ45-Type
2. Pin Configuration: T568B.
3. Mounting Configuration: Faceplates, Trim Plates, and Modular Patch Panels.
4. Colors:
   a. Jacks and/or termination labels may require color coding to differentiate applications types. Refer to drawings for additional requirements on color coding.

5. Cable Interface:
   a. Input: 110-Type (back).
   b. Output: RJ45-Type (front).
6. Electrical Specifications:
   a. ANSI/TIA/EIA-568-C.2:
   b. Insulation Resistance: 500 MegaOhms (minimum).
   c. Current Rating: 1.5A @68 ^{O}F (20 ^{O}C).
   d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
   e. UL and cUL Listed
   f. FCC Part 68.
7. Plug Requirements:
   a. Retention Force: 30-lb (133N).
   b. Insertion Life: 750 minimum.
   c. Plug/Jack Contact Force: 0.22-lb (100g).
8. Temperature
   a. Operating: +14 to +140 ^{O}F (-10 to +60 ^{O}C).
   b. Storage: -40 to +158 ^{O}F (-40 to +70 ^{O}C).

D. Faceplates:

1. General:
   a. Faceplates and/or trim plates shall be provided at each communication device location as necessary to install jacks.
   b. No communication device cable and outlet jack shall be installed without a faceplate to tightly secure assembly.
   c. All unused ports shall have a blank dust cover installed. The color of each dust cover shall match the faceplate color as closely as possible, unless otherwise indicated.
   d. Faceplate and/or surface box shall be provided at modular furniture locations. Coordinate requirements with Owner, Architect, and Engineer prior to purchasing components and initiating installation.
   e. Wall telephone locations shall use a modular faceplate with standard integrated mounting knobs for installing telephone handset to wall.
   f. Coordinate faceplate requirements at specialty locations for floor boxes, surface raceway, surface mount boxes, and other locations accordingly.
2. Material:
   a. Wall Devices: Stainless Steel.
   b. Floor Box Devices: Plastic (within Floor Box cover)
   c. Modular Furniture Devices: Plastic
   d. Surface Mounted Raceway Devices: Plastic
3. Type: RJ45 Standard Form Factor.

E. Style-Line Modular Faceplate Mounting Frames

1. Modular faceplate mounting frames shall be provided as necessary to support RJ-45 outlet jacks within all Floor Boxes and/or Surface Raceway.
2. Coordinate final color selection of mounting frames with Owner, Architect, and/or Engineer prior to purchase to ensure color matches floor box or surface raceway material finish. As a minimum, the color black shall be submitted for approval.

F. 106-Style Modular Faceplate Mounting Frames

1. Modular faceplate mounting frames shall be provided as necessary to support RJ-45 outlet jacks within all wall mounted TV outlets with combination power and data. Additionally, Contractor may elect to you this faceplate type for surface raceway devices.
2. Coordinate final color selection of mounting frames with Owner, Architect, and/or Engineer prior to purchase to ensure color matches floor box or surface raceway material finish. As a minimum, the color black shall be submitted for approval.

2.4 PATCH CORD REQUIREMENTS

A. General:

1. The patch cords shall meet the minimum requirements noted in Performance and Criteria Section for Category 6, and 6A as applicable based on ANSI/TIA/EIA-568-C.2 equivalent cable rating.
2. Patch cords shall be provided as part of project at main cross-connects, intermediate cross-connects, horizontal cross-connects, and communication device outlet locations.
3. Exact patch cords requirements including ANSI/TIA/EIA-568-C.2 category, quantity, and lengths shall be coordinated with Owner, Architect, and Engineer.
4. The sum of patch cord lengths when added the permanent basic link shall not exceed 325-feet (100m).
5. Construction: Unshielded Twisted Pair type.
6. Electrical Specifications:
   a. ANSI/TIA/EIA-568-C.2:
   b. UL and cUL Listed CM Cordage
   c. FCC Part 68.
7. Plug Requirements:
   a. Retention Force: 30-lb (133N).
   b. Insertion Life: 750 minimum.
   c. Plug/Jack Contact Force: 0.22-lb (100g).
8. Temperature
   a. Operating: 14 to +140 ^{O}F (-10 to +60 ^{O}C).
   b. Storage: -4 to +140 ^{O}F (-20 to +60 ^{O}C).
9. Lengths: Refer to Technology drawings (symbol legend) for additional requirements on various patch cord lengths.
10. Colors:
    a. Patch cords shall be colored to differentiate applications types. Refer to drawings for additional requirements on color coding and quantities.

B. Category 6 Patch Cords

1. General:
   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6.

C. Category 6A Patch Cords

1. General:
   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6A.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Labeling:

1. The labeling scheme shall be provided by the Contractor and coordinated with Owner, prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Each cable, wiring block, patch panel, and termination shall be identified at the main cross-connect (MC), at the intermediate cross-connect (IC), and at each station termination.
3. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

C. Horizontal Systems Cable Testing:

1. All communications copper horizontal cabling and pairs shall be tested for electrical continuity and wire map.
2. Cable testing shall confirm to the cables ANSI/TIA/EIA-568-C.2 rating.
3. All cabling will be test/certified for conformance to the ANSI/TIA/EIA-568-C.2 Category Category 5E, Category 6, and Category 6A specifications using TSB-67 Level 4 time domain reflectometer (TDR) or approved equivalent test equipment.
4. Cable tests will be per industry standard and also include the following:
   a. Cable Length
   b. Attenuation
   c. NEXT
   d. Characteristic Impedance
   e. Mutual Capacitance
   f. Resistance
   g. Noise
   h. Wire Map
5. (5) Printed test results shall be submitted on disc and printed copies by the Contractor for approval by Owner, Architect, and Engineer.

END OF SECTION 271500

SECTION 28 00 00 - SECURITY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections.

B. Drawings (Architectural, Electrical, and Technology/Security)

C. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. The term “provide” used throughout this specification and drawings shall mean “furnish, install, test, and certify”.

B. Coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Construction Manager and/or General Contractor and all necessary trades to ensure successful completion of work.

C. Phasing, temporary distribution/equipment, cut-over and implementation shall be coordinated with Owner, Construction Manager and/or General Contractor, Architect, and Engineer.

D. The Security System shall consist of the following integrated subsystems as specified herein and within other related specification sections:

1. Video Surveillance System
2. Wire and Cable

E. The Security System shall be a modification/addition to the existing WCMC security system.

F. All components shall be suitable for installation in facilities which may be subject to vandalism and other abuses.

G. The Contractor shall be responsible for providing complete, fully operational, and functionally integrated Security System to the Owner. This shall include, but not be limited to, all raceway, cabling, electronic components, power supplies, UPS units and hardware required to create such system. Any scope of work separation (i.e. raceway, data cabling, etc.) shall be determined by the General Contractor, unless noted otherwise.

H. The Contractor shall be responsible for providing a complete turnkey installation with the exception of those items noted as being provided by others, including but not limited to, all material, labor, warranties, freight and permits.

I. The Contractor shall be responsible for providing all labor and materials sub-contracted by the Contractor for completion of the project, whether or not that labor and materials is claimed by related trades or included as part of the project as described in this Specification.

J. The Contractor shall be responsible for providing all power supplies (including conduit, backboxes, wire and cable, fire alarm system interconnects, etc.) with the exception of those items noted as being provided by others, as described herein and as required by the various manufacturers.

K. The Contractor shall coordinate the installation of the Security System with the following related work of other sections:

1. Division 08 - Door Hardware
2. Division 26 - General Electrical Requirements

L. Contractor shall retain services of a Security Integrator from the authorized list below.

Redtop Group
Rick Springwaldt
Office 212.271.4500 X501
Mobile 917.416.8598
rspringwaldt@redtopgroup.com
www.redtopgroup.com

JC Security Systems
John Conte
Bayside, NY 11360
(718) 352-3914 (office)
(718) 352-8368 (fax)
www.jcsecuritysystems.com

Care Security Systems
Edward C Spitzbarth
7 Hemion Road
Montebello, NY 10901
(845) 354-3367 ext 152 (office)
(845) 642-8286 (cell)
espitzbarth@care-Inc.com

1.3 SUBMITTALS

A. General Description and Requirements

1. Submittal Schedule:
   a. Within two weeks after award of contract, the Contractor shall submit a proposed schedule for submitting product data and shop drawings. At a minimum, the following items shall be included:
      1) Submittal date for Product Data.
      2) Submittal date for Shop Drawings.
      3) Submittal date for Commissioning and/or Test Results.

4) Submittal date for As-Builts.

b. Within 45 days after award of contract or as dictated by the construction schedule (whichever period of time is shorter), the Contractor shall submit prefabrication submittals consisting of product data and shop drawings for approval. Partial submittals will not be accepted without prior written approval from the Architect/Engineer.

2. No portion of the project shall commence nor shall any equipment be procured until the prefabrication submittals have been approved in writing by the owner and Engineer. All installations shall be in accordance with the Contract Documents.
3. A detailed completion schedule shall be submitted with the prefabrication submittals.
4. Prefabrication submittals shall be accompanied by a letter of transmittal identifying the name of the project, Contractor's name, date submitted for review, and a list of items transmitted.

B. Product Data:

1. Warranty Information: Provide all warranty information as described in this specification section for review and approval.
2. Component List: Provide complete submittal component list at the beginning of the submittal package. Component list shall identify each component name, manufacturer, and specific product/part number. All part numbers shall clearly indicate special options, color, accessories, etc.
3. Cutsheets: Submit manufacturer’s cut-sheets on all components listed within this specification.

C. Shop Drawings and As-Built Drawings: Submit drawings of on proposed layout(s) of security systems components. The following drawings shall be submitted for review by Architect, Engineer, and Owner; prior to commencing installation of any security systems components:

1. Legend: Provide drawings including descriptions of all abbreviations and symbols.
2. One-Line Diagrams: Provide drawings that indicate all equipment components, locations, integration, etc. as required to complete a fully functioning security system as described throughout the security specifications and drawings.
3. Plans: Provide scaled plan drawings (with current reflected ceiling plan layer shown) based on architectural background indicating device and equipment locations including, but not limited to; raceways (including pull-boxes), equipment racks/cabinets, video cameras, camera mounting hardware, power supplies, video cables, data cables, patch cords (data, video, component, DVI, etc.), power cables, PTZ control cables, and any other components as required to complete the security system. Additionally, provide wiring diagrams for indicating cable origination and routing.
4. Labeling: Provided documentation of all labeling schemes for conduit, back-boxes, junction boxes, cable, outlets, device faceplates, etc. Additionally, all electronic equipment shall be labeled including equipment racks/cabinets, security control panels, video cameras, IP encoders (as necessary), power supplies, enclosures, etc. Contractor shall coordinate labeling of all components with the Owner, Architect, and Engineer prior to commencing work.
5. Documentation: Provide a minimum of one (1) hardcopy set of prints for review if the Division 1 requirements do not require hard copies. Coordinate with General Contractor or Construction Manager to ensure submission is per project requirements.

6. As-Built Drawing Documentation: All documentation shall be shall be provided as AutoCAD (2014 version) files or as specified in the Division 1 requirements. Additionally, provide an electronic PDF copy of As-Built Drawings to the Engineer upon project close-out. Coordinate with General Contractor or Construction Manager to ensure submission is per project requirements.

D. Security Software Documentation

1. The Contractor shall be responsible for coordinating with the Owner to identify:
   a. Any specific needs pertaining to management of the security software.
   b. Preferences for operator interaction with the security software.
   c. Special sequences and/or procedures that fall under the category of Contractor programming or system options.
2. All coordination with the Owner shall be fully documented by the Contractor and included in the record documentation.

1.4 QUALITY ASSURANCE

A. Codes and Standards
The Security System shall be installed in accordance with all applicable national, state and local codes and standards including, but not limited to the following:

1. Americans with Disabilities Act (ADA).
2. Local Governing Codes and Standards.
3. National Fire Protection Association, National Electrical Code (NFPA 70).
4. National Fire Protection Association Life Safety Code (NFPA 101).
5. Underwriters Laboratories Applicable Standards for Safety (UL).
6. Underwriters Laboratories Applicable Standards for Proprietary Security System (UL).
7. ANSI/EIA/TIA-526: Standard Test Procedures for Fiber Optic Systems.
8. ANSI/EIA/TIA-568C.0: Generic Telecommunications Cabling for Customer Premises.
9. ANSI/EIA/TIA-568C.1: Commercial Building Telecommunications Cabling Standard.
10. ANSI/EIA/TIA-568C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
11. ANSI/EIA/TIA-568C.3: Optical Fiber Cabling Components Standard.
12. ANSI/EIA/TIA-569A: Commercial Building Standard for Telecommunications Pathways and Spaces.
13. ANSI/EIA/TIA-607: Commercial Building Grounding and Bonding Requirements for Telecommunications.
14. BICSI CO-OSP Design Manual (current edition): Customer-Owned Outside-Plant Design Manual.
15. BICSI Network Design Reference Manual (current edition).
16. BICSI TDMM Telecommunications Distribution Methods Manual (current edition).
17. BICSI Wireless Design Reference Manual (current).
18. EIA/TIA TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling.
19. EIA Compliance: Comply with Electronic Industries Association's Standards RS-170, RS-232, RS-312, RS-330, and RS-420 for closed-circuit TV cameras, monitors and component interfaces.

20. FCC Compliance: Comply with Subpart J of PART 15, FCC Rules pertaining to computing devices including Class A, Class B, personal and peripheral types. Provide equipment which complies with technical standards for both radiated and power line conducted interference.
21. IEEE-208 Video Techniques: Measurement of Resolution of Camera Systems.
22. IEEE-802.11 a, b, g: Wireless Local Area Networks.
23. IEEE-802.3: 10Mb/s, 100Mb/s, 1Gb/s, and 10Gb/s Ethernet Standards as applicable based on media types (twisted pair copper, fiber optics, etc.).
24. IEEE-802.3ak: 10Gb/s Ethernet (evolving copper standard).
25. IEEE 1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
26. ISO/IEC 11801: International Standard on Information Technology – Generic Cabling of Customer Premises.
27. NEMA Std 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
28. NEMA Compliance: Comply with requirements of Stds Pub/No. WC 41, "Coaxial Communication Cable," pertaining to testing of coaxial cable.
29. NFPA-70/NEC: National Electrical Code.
30. UL Compliance: Comply with applicable requirements of UL Standards 983, 1409, 1410, 1412, 1414, 1416, 1417, and 1418 pertaining to CCTV and video products. Provide CCTV systems and components which are UL-listed and labeled.
31. Other applicable codes, standards, and installation procedures consistent with recognized industry standards, trends, and generally accepted procedures.
32. Owner Design and Construction Standards

B. Manufacturer and Product Qualifications

1. Provide products from manufacturers regularly engaged in the production of security system components, including but not limited to, video surveillance, access control, and intrusion detection systems hardware and software.
2. Provide products from manufacturers whose products of similar types, capacities, and characteristics have been in satisfactory use in similar type projects for not less than five years.
3. The systems (including software, hardware and firmware) proposed for this project shall have been installed in at least one project of similar size and nature and shall have been in beneficial use for at least 24 months prior to submission of the bid proposal.
4. The Contractor shall provide at the time of installation the latest version of all equipment hardware and software. Discontinued equipment shall not be acceptable.

C. Contractor Qualifications

1. The project specified herein shall be the responsibility of a single electronic security systems integration contractor. The Contracting firm shall document in its bid packages that it has a minimum of five (5) years experience in the installation of systems of similar complexity as specified herein. The documentation shall include the names, locations and points of contact for at least three (3) installations of the type and complexity specified herein where the Contractor referred to above has installed such systems. The Contractor shall indicate the type of each referenced system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 24 months.

2. The contractors shall be Identiv (formerly Hirsch) and Vicon certified and shall have a NY State Fire Alarm Installation License.
3. The Contractor shall have a fully staffed local office including service center within the project area capable of providing comprehensive maintenance and service to the specified systems. The service center shall be staffed by factory trained technicians and adequately equipped to provide emergency service within four (4) hours after being called, 24 hours per day, whether or not the Owner elects to purchase a maintenance contract with the Contractor.
4. The Contractor shall provide factory certified technicians to install and maintain the systems provided. All installing personnel shall be licensed as required by local jurisdiction. The Bidder shall provide information in the proposal to demonstrate compliance with this requirement, including copies of appropriate factory certifications.
5. The Contractor shall ensure compliance with and have an understanding of all local code and contract conditions pertaining to this project.
6. The Contractor shall maintain an inventory of spare parts and other items critical to system operation as necessary to meet the emergency service requirements within the local service center.
7. The Contractor shall have local in-house engineering and project management capabilities consistent with the requirements of the project. The Contractor shall provide a full-time project manager who is to be present on site at all times that installation is actively in progress. This person shall be the same individual throughout the course of the Project and shall be the person responsible for system programming, preparation of Operation and Maintenance Manuals, Training Programs and Schedules and Test Protocols, documentation of system testing, maintenance of record drawings, coordination and scheduling of all subcontract labor. The Owner reserves the right to approve the Contractor's project manager.
8. By submitting a bid, the Contractor thereby certifies that it is qualified in all areas pertaining to, either directly or indirectly the project. In the event the Contractor becomes unable to complete the project in accordance with the Contract Documents, or the satisfaction of the Owner or his representatives, due to a lack of understanding of equipment, systems or services required by the Contract Documents, it shall be the responsibility of the Contractor to retain the services of the applicable manufacturers' representatives to expeditiously complete the project in accordance with the construction schedule with no additional cost to the Owner.

D. Coordinated Work

1. It is understood that the Work as described in this Specification is contingent on other trades and work. Therefore, the Contractor shall coordinate with related trades to schedule this Work with related trades and ensure a complete installation in accordance with the schedule outlined by the Construction Manager.
2. The Contractor shall carefully examine the Contract Documents, all related equipment schedules and installations, related Architectural and Engineering drawings, etc. to ensure compatibility between the Security System design, related packages and applicable site conditions.
3. Within the Specification and as shown on the Security System Drawings, specific mounting heights and general device locations are specified. Architectural and related Engineering Drawings should be carefully examined to coordinate final equipment/device locations, facility designations, floor accessibility, floor type, ceiling heights and ceiling types. The

exact mounting locations and mounting heights of all equipment shall be verified with the Architect and Owner prior to installation. The Contractor shall notify the Construction Manager in the event that a particular location appears to be unsuitable.

1.5 DELIVERY STORAGE AND HANDLING

A. The Contractor shall be responsible for coordinating the delivery of all security system products to the site with the Construction Manager. All components shall be properly packaged in factory-fabricated type containers.

B. The Contractor shall ensure that all security system products stored on site and/or in the Contractor's facilities are protected from theft or damage. All components shall be stored in original cartons and in a clean dry space protected from weather and construction traffic.

C. The Contractor shall handle all security system components carefully to avoid breakages, impacts, denting and scoring finishes. Do not install any damaged equipment; replace and return damaged units to equipment manufacturer.

1.6 SEQUENCING AND SCHEDULING

A. The Contractor shall schedule all site activities with the Construction Manager.

B. The Contractor shall be responsible for scheduling with related trades to ensure that all contingent installations will be completed in accordance with construction schedule.

1.7 PROJECT SITE CONDITIONS

A. Prior to submitting a proposal, the Contractor shall inspect the Contract Documents, and shall become fully informed as to laws, ordinances, and regulations affecting the project. The Contractor shall immediately bring to the Engineer's and Architect's attention, in writing, any existing condition or statute that contradicts, is in conflict with, or negates the Contract Documents. Failure of the Contractor to become fully informed as to all above mentioned items shall in no way relieve the Contractor from any obligations with respect to their proposal.

B. The Security Device Drawings depict equipment locations, backboxes, conduit runs, feeders and wiring in a schematic manner. Field conditions and coordination with related trades may warrant relocations of field devices. No additional compensation will be allowed due to these revisions.

1.8 WARRANTY

A. A one (1) year warranty on the Work, starting on the date of final acceptance by the Owner, shall be provided by the Contractor. If, within one (1) year after the date of final acceptance of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by

Owner representatives, to be identified, either verbally or in writing.

B. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents or any manufacturer's warranty. The establishment of the time period (indicated above) after the date of final acceptance or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the work or equipment, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the work or equipment.

C. Preventative maintenance shall be performed by the Contractor during the warranty period and shall include but not be limited to a quarterly maintenance check of all system components which will include cleaning, adjustments and necessary repairs. The Contractor shall submit a list of items to be included in the preventative maintenance program. The list shall include maintenance to each item, the frequency of such maintenance, and the amount of time to be spent on each item for maintenance.

D. The Contractor shall provide written notice to the Owner documenting any work performed during the warranty period, including any preventative maintenance work performed. Loaner equipment shall be provided for any equipment not field repairable. Such loaner equipment shall be in working order and the functional and technical equivalent of the item replaced.

E. Repair or replacement service during the warranty period shall be performed in accordance with the following schedule:

1. Schedule A - 7 days, 24 hour, 4 hour response time.
2. Schedule B - 8:00-5:00 business days, excluding holidays, 4 hour response time.

F. Schedule A shall apply for major system components including but not limited to the Security Control Panels and associated products.

G. Schedule B shall apply for all other components and devices. The Contractor shall provide as part of his bid an after-hours labor rate for any warranty service required during hours not covered under Schedule B.

H. If system operation is not fully restored during the warranty period within two (2) business days, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

I. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment of system being expanded.

J. The Contractor shall provide for on-line software maintenance and support during the warranty period. All software and hardware, including telephone modems, shall be provided by the Contractor. Modem access to the system shall be password protected and controlled by the Owner.

1.9 MAINTENANCE

A. The Contractor shall provide a Add Alternate to include annual costs for the second through fifth years, for a maintenance contract to provide repair service including all parts and labor and a Preventative Maintenance Program on the Security System. The Contractor shall provide a list of all items, schedule, and services included in the Preventative Maintenance Program with the bid.

B. The Contractor shall provide a quote for a manufacturer's software maintenance agreement after the warranty period has expired. The maintenance agreement shall include all software updates, revisions and telephone service assistance. The software maintenance agreement shall include training for any changes in operation due to the software revisions. The period for this software maintenance agreement shall be consistent with the Preventative Maintenance Program noted above.

C. The Preventative Maintenance Program shall include, but not be limited to a quarterly maintenance check of all system components which will include cleaning adjustments and all necessary repairs. The Contractor shall submit a list of items to be included, the frequency of such maintenance, and the amount of time to be dedicated to the preventative maintenance program. A written notification shall be given to the Owner outlining any work performed and noting any foreseeable problems. Loaner equipment will be provided for any equipment not field repairable. Such loaner equipment shall be in working order and the functional and technical equivalent of the item replaced.

D. Repair or replacement service for the second through fifth year after the warranty period has expired shall be performed in accordance with the following schedule:

1. Schedule A - 7 days, 24 hour, 4 hour response time.
2. Schedule B - 8:00-5:00 business days, excluding holidays, 4 hour response time.

E. Schedule A shall apply for major system components including but not limited to the Security Control Panels and associated products.

F. Schedule B shall apply for all other components and devices. The Contractor shall provide as part of his bid an after-hours labor rate for any maintenance service required during hours not covered under Schedule B.

G. If system operation is not fully restored under the maintenance contract within two (2) business days, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

H. The Contractor shall provide for on-line software maintenance and support during the maintenance period. All software and hardware, including telephone modems, shall be provided by the Contractor. Modem access to the system shall be password protected and controlled by the Owner.

1.10 SPECIFICATION RESPONSE

A. Pricing

1. Instructions to Bidders
   a. The following is a partial list of instructions. Bidders are responsible to provide a complete proposal inclusive of all information requested in the Contract Documents.
   b. Do not assume anything. Feel free to clarify your position in writing with your bid concerning any areas that may not be clear to you.
   c. Copies of the bid proposal shall be submitted to the Architect for review and approval.
   d. Bidders shall prepare equipment lists showing each item included in the bid. Equipment Lists must include the quantity, model number, manufacturer and price of each item listed under the generic description.
   e. Provide a detailed description of any and all voluntary alternates and include cost changes in the Voluntary Alternate Bid forms. Bidders should submit voluntary alternates that will either provide for a better system or reduce costs without degrading the system.
   f. In the instance where the Drawings and the Specifications do not directly coincide, or coincide individually, the item of better quality, greater quantity and/or higher cost shall be included in the base bid.
   g. Bidders shall review all equipment models with WMC Security prior to bid. Bidders shall allow for up to (2) site meetings with WMC Security to review equipment.

B. Compliance

1. Bidders shall submit a Statement of Qualifications with their bid proposal that shall include the following information:
   a. Company name, address, telephone number and contact person.
   b. Brief company history.
   c. Resumes of key personnel.
   d. Local staffing description (job descriptions and numbers of persons in each position).
   e. Local service capabilities (hours of operation and parts availability).
   f. Technician factory certifications.
   g. Description of local engineering and project management capabilities.
   h. Line sheet listing major suppliers of security equipment.
   i. Annual dollar value of sales, installation and service of each product line carried.
   j. List of references describing three (3) completed projects of similar size and complexity, including names and telephone numbers of the contact persons.
   k. List of references describing similar projects completed in the area including names and telephone number of the customer's contact person.
   l. List of similar projects currently under construction in the area including names and telephone numbers of the customer's contact person.
   m. Licensing information.
2. Additionally, as described in this Specification, bidders shall submit the following information with their bid proposal:
   a. Proposed System Manufacturer's source code agreement.
   b. Maintenance Agreement and a Sample Maintenance Contract describing the nature of the Maintenance Service to be provided after the warranty period has expired.
   c. After hours labor rate for any warranty service required during hours not covered

under Schedule B.

d. List of all items, schedules, and services included in the Preventative Maintenance Program.
e. A quote for a manufacturer's software maintenance agreement after the warranty period has expired.
f. Manufacturer's literature sheets for all standard manufactured items included in the equipment list and as proposed in the Voluntary Alternate Bid form, if applicable.
g. Workload and capability statements. The statements shall detail projects that will be active during the completion of this project, and the manpower that would be available for this project.
h. Confidentiality and return statements. The statements shall guarantee that the Contract Documents shall not be copied or distributed physically or verbally. The Contractor shall also assure the Owner that the Contract Documents shall be returned in their entirety upon request. The successful Contractor will be provided with as many copies as requested.

3. Certain paragraphs of the Specification require the Bidder to provide information (possibly not listed above) in the proposal to demonstrate compliance with a requirement. If the Bidder fails to provide detailed responses to these items, the proposal will be deemed to be non-compliant to the paragraphs stated.
4. Number all pages of the bid submittal.

1.11 ABBREVIATIONS AND DEFINITIONS

A. Refer to Security System (i.e. Technology System) Symbol Legend sheet for abbreviations and/or device symbol clarification.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment shall be reviewed with WMC Security group prior to purchase.

2.2 CCTV SYSTEM

Device name	Manufacturer	Part number	Type
Encoder	VICON	ENC-H264-16	H.264 16-channel digital video encoder; 480 fps (total), ViconNet; audio input/output; PoE capable
Indoor Vandal-Resistant Dome Camera	Vicon	V944D-W312MIR	OUTDOOR FIXED NETWORK CAMERA DOME; 4 MP; H.264/H.265; vandal-resistant; includes 1/3-in. high-resolution day/night camera and 2.7-12 mm motorized varifocal lens; IR illuminators; true 120dB WDR
Indoor Hemispheric Network Dome Camera	Vicon	V9360-6	HEMISPHERIC INDOOR CAMERA; 6 megapixel, 180°/360° panorama, built-in fisheye lens, ePTZ view
Oudoor Hemispheric Network Dome Camera	Vicon	V9360W-6	HEMISPHERIC OUTDOOR CAMERA; 6 megapixel, 180°/360° panorama, built-in fisheye lens, ePTZ view

Network Video Recorder	Vicon	VLR-34TB-R5	1U RECORDING SERVER; for Valerus. Preloaded with NVR software; includes internal RAID with 48 TB raw storage and 34 TB usable storage and redundant power supply; 4-bay; RAID5; i5 processor; rack-mount. Vicon certified hardware. Requires separate device connection license.
PoE Switch	Cisco	SF300-48PP-K9-NA	48 10/100 PoE+ ports with 375W power budget, 2 10/100/1000 ports, 2 combo mini-GBIC ports

A. Provide all mounting hardware and accessories as required for full installation.

B. Provide (1) NVR and (1) PoE switch (1) power supply for cameras for the project, unless noted otherwise. Equipment shall be turned over to WMC Security for installation.

C. Wiring:
1. Provide green Cat6 cable between each camera and a security network switch. Refer to plans for switch locations.
2. Provide (1) 18/2 for power for all outdoor camera locations from power supply.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall examine areas and conditions under which security systems are to be installed and notify Construction Manager, Architect and Engineer in wiring of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. The Contractor shall verify that the site conditions are in agreement with the Contract Documents and the design package. The Contractor shall submit a report to the Construction Manager documenting changes to the site or conditions that affect the performance of the system to be installed. For those changes or conditions which affect system installation or performance, provide (with the report) specification sheets, or written functional requirements to support the findings, and a cost estimate to correct the deficiency. The Contractor shall not correct any deficiency without written permission from the Owner.

3.2 INSTALLATION

A. General

1. Install all security systems components where indicated, in accordance with equipment manufacturer's written instructions, in compliance with all previously listed codes or standards, and with recognized industry practices, to ensure that all components comply with requirements and serve intended purposes.
2. Use extreme care in handling, fishing and pulling-in electronic cable to avoid damage to cable and jacket. Avoid excessive and sharp bends.
3. Install security system equipment properly to avoid causing mechanical stresses, twisting or misalignment or equipment being exerted by clamps, supports, and cabling.

4. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

B. Security System Programming and Setup

The Contractor shall provide all initial system setup including, but not limited to the following:

1. System network programming shall be by Owner.
2. Initial camera aiming and setup (focus.)

C. Equipment

1. All equipment models shall be reviewed with WMC Security prior to bid. Contractor shall allow for up to (2) site meetings with WMC Security to review equipment.
2. All equipment locations shall be reviewed with WMC Security prior to installation. Contractor shall allow for up to (2) site meetings with WMC Security to review installation.
3. The exact mounting locations of all equipment shall be verified with the Engineer and Owner prior to installation. The Contractor shall notify the Construction Manager in the event that a particular location appears to be unsuitable.
4. Tamperproof fasteners shall be used on all equipment in public areas. Fastener finish shall match equipment finish.
5. Finish and graphics for all equipment in public areas shall be submitted to, and approved by, the Engineer and Owner prior to installation.
6. All visible panel and control labels shall be silkscreened, engraved or filled, or engraved plastic laminate. All labels shall be submitted to, and approved by, the Architect, Engineer and Owner prior to fabrication.
7. The Contractor or equipment manufacturer logos or names shall not be visible on equipment in public areas.

D. Grounding

1. Provide equipment grounding connections for security systems as indicated and per manufacturer recommendations. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds. Ensure and demonstrate that resistance to solid earth for signals in less than, or equal to 3 ohms.

E. Adjusting and Cleaning

1. Set field-adjustable cameras to obtain the proper view as intended per the drawings and camera schedules. In addition, exact camera field of view shall be reviewed and confirmed with the Owner.
2. Set field-adjustable video surveillance system components for input voltages, current settings and frequency settings.
3. Touch-up scratched and marred surfaces to match original finishes; remove dirt and construction debris.

3.3 CONDUIT, BOXES AND RACEWAYS

A. Boxes and Wireways

1. Field boxes and cabinet enclosures containing remote system electronics and/or circuit boards shall contain a wiring chart delineating wire routings, labeling and termination points. The chart shall be housed in a clear plastic sleeve affixed to the inside of the enclosure cover.

B. Conduit

1. All conduit materials and workmanship included in this Work shall be in strict compliance with the latest edition of the National Electrical Code (NEC) and applicable local electrical codes.
2. Certain conduits, boxes, and raceways are to be provided by others as shown on the Drawings. The Contractor shall be responsible for providing any additional conduits, boxes and raceways that are required to provide a complete installation. The Contractor shall be responsible for ensuring that all conduit, backboxes and raceways meet equipment and wiring requirements for the system.
3. All system electronics located in the field shall be mounted within junction boxes. The Contractor shall provide conduits, boxes and raceways as required to adequately accommodate all field electronics.
4. All conduit installed shall be EMT (of milled steel tubing), except where exposed to any water or moisture, or unless otherwise, securely fastened in place as required by code and as specified hereinafter. Compression type fittings shall be used for all EMT terminations and connections.
5. For exterior applications or where conduit will be exposed to moisture, or where buried in slab, hot dipped galvanized steel conduit shall be used.
6. Flexible conduit shall be used to extend conduit connections to permanently connected equipment, but in no case shall the length of flexible conduit exceed 24" for connection of any one piece of equipment. Provide ground wire from conduit to the equipment to maintain continuity.
7. In no instance shall the diameter of conduit installed be less than 3/4". When conduit sizes larger than 1-1/2" are specified, use standard elbows for all bends 45 degrees and larger. Field bends shall be permitted for conduit bends less than 45 degrees, provided the cross-sectional area of the conduit is not reduced and the conduit is in no way damaged.
8. Conduit in finished areas shall be installed concealed in chases, furrings, concrete slabs and/or above suspended ceiling. The intent is that vertical conduit be provided in all finished spaces up into the accessible ceiling. Once in the ceiling, cable can be routed exposed, provided it is plenum rated as required by code. Conduit in exposed spaces shall be exposed from the junction or pull box, vertically and horizontally until said conduit can be extended into accessible ceiling. Installation of the conduit shall be square and parallel to the building and shall be securely supported. Conduits shall be grouped wherever it is feasible to do so. All backboxes and pull-boxes shall be plumb and square and parallel to the building and shall be securely supported.
9. All conduit shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.
10. All required inserts shall be drilled-in and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.

11. All conduits shall be swabbed out and burrs removed before any wires are pulled.
12. The Contractor shall lay out and install conduit runs as to avoid proximity to hot water/steam pipes. In no case shall a conduit be run within three (3) inches of such pipes, except where crossing are unavoidable and then the conduit shall be kept at least one (1) inch from the covering of the pipe crossed.
13. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and in Division 26 and/or 27 to provide a neat, workmanlike installation. Where riser conduit protrudes through floors slabs, they shall be supported by approved riser clamps. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets or heavy iron tie, tied to the black iron structural member supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.
14. Straight runs of conduit shall have pull boxes as required by the National Electrical Code where conduit runs are not broken by junction boxes or outlet boxes. Conduit runs with bends shall have additional pull boxes as required to not exceed maximum allowable pulling tension of cable.
15. Threaded conduit shall be secured to boxes, cabinets, etc. by means of galvanized or sherardized threaded bushing on the outside of such boxes and cabinets. Fittings shall be watertight and the same materials as the conduit installed. Damaged raceways and fittings shall not be installed or accepted.
16. Provide fire stops where conduits penetrate fire rated wall and/or floors.
17. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the Architect and Engineer through the shop drawing review process.

3.4 WIRING TECHNIQUES

A. All wiring shall be run within conduit, or plenum type cable shall be used in return air plenum spaces, or as required by code.

B. Code compliant fire proofing techniques shall be provided by the Contractor for all penetrations of fire rated partitions and slabs, where the penetrations are made by or used by the Contractor.

C. All cable and wiring methods shall meet national, state and local code requirements and shall be ULC listed for their application.

D. The Contractor shall be responsible for coordinating the routing of wire and cable requiring isolation from power, radio frequency (RF), telephone, etc.

E. All cables must be run continuous from device location to the final point of termination. No mid-run cable splices will be allowed.

F. The Contractor shall be responsible for visually inspecting wire and cable for faulty insulation prior to installation.

G. Provide grommets and strain relief material where necessary, to avoid abrasion of wire and excess tension on wire and cable.

H. Make connections with solderless devices, mechanically and electrically secure in accordance with the manufacturer's recommendations.

I. A single "system ground" point shall be established within the security console room for the system. The system ground shall consist of a single grounding point to which all grounds in the system are connected. Under no conditions shall the AC neutral either in a power panel or in receptacle outlets be used for a reference ground. The Contractor shall be responsible for establishing the ground point and ensuring that no ground loops are created.

3.5 POWER REQUIREMENTS

A. 120V AC power on generator backup (Life Safety branch, unless noted otherwise) shall be provided within each Communications Room for use by the security system. Contractor shall refer to Power Drawings for additional requirements.

B. The Contractor shall connect to the AC power and provide ULC listed power supplies and transformers to distribute low voltage power to the system components.

C. Provide hinged cover terminal cabinets with tamper switches for all power supplies, transformers and power distribution terminal strips. Provide all conduit and wiring from the AC power facilities to the terminal cabinets.

D. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components.

3.6 LABELED DOORS AND FRAMES

A. In no instance shall any ULC labeled door or frame be drilled, cut penetrated, or modified in any way.

B. The Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the Architect.

3.7 LABELING

A. All cables shall be marked in common at both ends using a permanent method such as self laminating write on cable marking tape. The tags shall be attached to the wire and cable nylon cable ties in an accessible location so that they can easily be read. Ties shall be similar to T&B TyRap cable ties. Tags shall be installed when wire and cables are installed. Device and cable labeling shall be coordinated with the Owner and shall agree with record drawings.

B. Wire identification number shall be placed at each end of the conductor involved by using sleeve type, heat shrinkable markers. The markers shall be installed so as to be readable from left to right or top to bottom.

C. All connectors shall be marked with common designations for mating connectors. The connector designations shall be indicated on the record drawings.

D. Spare conductors are to be coiled in the device back-box, panel wireway, or top of panel where wireway is not provided. These conductors shall be neatly bundled and tagged.

E. Each data outlet at each security device shall be tagged in following manner: comm room#.patch panel#.port#.

F. Each data cable at patch panel shall be labeled with the door number served by the cable.

G. Each security terminal in the security panel shall be labeled with the door number served by the circuit.

3.8 SYSTEM START-UP

A. The security system shall be complete and ready to operate prior to Owner final acceptance of the system. The Contractor shall be responsible for preparing all systems for user operation.

B. The Contractor shall label all controls as necessary to agree with their function.

3.9 RECORD DOCUMENTATION

A. Prior to the final acceptance of the Work, the Contractor shall submit record documentation sets to the Construction Manager as indicated in Division 1 General Conditions.

B. Record documentation shall include all information required in the prefabrication submittals but revised to reflect "as installed" conditions. Record documentation shall, at a minimum, include the items described previously under the Shop Drawings and As-Built Drawings section.

C. Record documentation shall include Contractor generated operation and maintenance manuals for all devices, equipment and software modules. Manuals shall include the following:

1. Operational description of each system.
2. Detailed programming descriptions for each system, including step by step procedures.
3. Explanations of system interrelationships. Explanations shall include operations of each system and operations unique to the interfaces between each of the systems and possible conflicts that may occur with the interfaces. Each explanation shall be identified, tagged, bound and indexed into a single binder.
4. Power-up and power-down procedures for each system.
5. Description of all diagnostic procedures.
6. An error list indicating all messages that may be displayed on each system and a description of the operator response to each.
7. A menu tree for each system. The tree shall provide a graphical flow of commands within the menu system.
8. Setup procedures for each component of the systems.
9. A list of manufacturers, their local representatives and subcontractors that have performed work on the project. The list shall include contact names, phone numbers and addresses for each.
10. Installation and service manuals for each piece of equipment.
11. Maintenance schedules for all installed components. Schedules shall include inspections and preventative maintenance schedules, and documentation of all repaired or replace

equipment.

D. Final copies of the manuals as specified, bound in hard-back loose-leaf binders, shall be delivered to the Owner within 30 days after completing the performance verification test. The draft copy used during the site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and system, and nearest service representatives for each item of equipment for each system. The manual shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. Any hardware manual demonstrating more than one (1) model number of device on any one (1) page shall be clearly marked as to delineate which model has been implemented into the Project. The final copies delivered after completion of the performance verification test shall include all modifications made during installation, checkout and acceptance.

E. Manuals

1. Hardware manuals shall include, at a minimum, the following information:
   a. General hardware description and specifications.
   b. Installation and checkout procedures.
   c. Equipment electrical schematics and layout drawings.
   d. System schematics and wiring lists.
   e. System setup procedures.
   f. Manufacturer's repair parts list indicating sources of supply.
2. Operator's manuals shall explain all procedures and instructions for operation of the system including:
   a. SMS system
   b. Camera and video recording equipment.
   c. Use of the software.
   d. Operator commands.
   e. System start-up and shut-down procedures.
   f. Recovery and restart procedures.

3.10 SYSTEM ACCEPTANCE

A. Final acceptance testing of the system will be conducted by the Owner, Architect, and Engineer.

B. Prior to any final acceptance testing, the Security Contractor shall submit all record documentation as described above.

C. The Contractor shall submit a paragraph by paragraph completion matrix indicating completion or delinquency for each item included in the Specification and all subsequent addenda and bulletins to the base contract. Indicate completion of the requirement by the word "Completed" following each paragraph number. Indicate delinquency for the requirement by the words "To Be Completed" following the applicable paragraph number. Should work on any item be under way, but not yet fully complete, the Contractor shall indicate the extent (or lack thereof) of completion to date.

D. The Security Contractor shall conduct a complete test of the entire system and shall provide the Architect with a written report on the results of that test. During the course of the Contractor's

system test, the Contractor shall calibrate and test all equipment, verify data transmission media (DTM) operation, place the integrated system in service, and test the integrated system.

E. Following completion of the Contractor's system test and correction of any noted deficiencies, the Contractor shall conduct a burn-in test for a minimum of 10 days. The intent of such test shall be to prove the system by placing it in near real operating conditions. During this period the system shall be fully functional and programmed such that all system points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. The Contractor shall record and correct any system anomaly, deficiency, or failure noted during this period. Scheduling of the final acceptance test shall be based on a review of the results of this burn-in test.

F. The Contractor shall deliver a report describing the results of functional tests, burn-in tests, diagnostics, calibrations, corrections, and repairs including written certification to the Architect that the installed complete system has been calibrated, tested, and is fully functional as specified herein. The report shall include a "Point List" printout from the system of all input and output points in the system. This "Point List" shall be used in conjunction with the preliminary record drawings by the Architect to conduct the system final test.

G. Prior to the final acceptance test, the Contractor shall coordinate with the Construction Manager and related trade representatives for security related construction clean-up and patch work requirements. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove all waste materials, rubbish, the Contractor's and his/her subcontractors' tools, construction equipment, machinery and all surplus materials.

H. Upon written notification from the Contractor that the system is completely installed, integrated and operational, and the burn-in testing completed, the Architect shall conduct a final acceptance test of the entire system.

I. During the course of the final acceptance test by the Owner, the Contractor shall be responsible for demonstrating that, without exception, the completed and integrated system complies with the contract requirements. ALL PHYSICAL AND FUNCTIONAL REQUIREMENTS OF THE PROJECT SHALL BE DEMONSTRATED AND SHOWN. This demonstration will begin by comparing "as built" conditions of the system to requirements outlined in the Specification, item by item. Following the Specification compliance review, system head-end equipment will be evaluated.

J. In order to sufficiently demonstrate the system's functionality, the SMS operator on duty and his/her superior will be requested to perform certain daily operations inherent to the system. These operations may include, but not be limited to, manually locking and unlocking doors within the system, video camera call-up, intercom system utilities, verifying the current status of various points within the system, and responding to and acknowledging alarms. Furthermore, the SMS operator and his/her superior will be requested to perform such tasks as entering information into the SMS System Data Base, generating various types of reports, adding a video camera to the viewing window, and manipulation of map graphics (addition/deletion of icons, etc.). As all of these operations depend heavily on the training outlined within the Specification, the Contractor shall have completed all of the required training prior to initiation of the final acceptance test.

K. The functionality of the various interfaces between systems shall be demonstrated. This will include, but not be limited to, correct camera call-up on certain alarms within the system, generation of alarms from related systems failure (i.e. loss of communications, UPS alarms, etc.), fire alarm system fail safe lock release, and interface to any external control and/or data base system(s).

L. Typically prior to the Security System head-end equipment and console review, the installation of all field devices will be inspected. This field inspection will weigh heavily on the general neatness and quality of installations, complete functionality of each individual device, and mounting, back-box and conduit requirements compliance.

M. All equipment shall be on and fully operational during any and all testing procedures. The Contractor shall provide all personnel, equipment, and supplies necessary to perform all site testing. The Contractor shall provide a minimum of two employees familiar with the system for the final acceptance test. One employee shall be responsible for monitoring and verifying alarms while the other will be required to demonstrate the function of each device. The Contractor shall supply at least two (2) two-way radios for use during the test. A manufacturer's representative should be available on site to answer any questions beyond the technical capability of the Contractor's employees.

N. Upon successful completion of the final acceptance test (or subsequent punch list retest) the Architect will issue a letter of final acceptance.

O. The Owner/Engineer retains the right to suspend and/or terminate testing at any time when the system fails to perform as specified. In the event that it becomes necessary to suspend the test, all of the Owner's fees and expenses related to the test will be deducted from the Contractor's retainage. Furthermore, in the event it becomes necessary to suspend the test, the Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the plans. The Contractor shall supply the Architect with a detailed completion schedule outlining phase by phase completion dates and a tentative date for a subsequent punch list retest. During the final acceptance test, no adjustments, repairs or modifications to the system will be conducted without the permission of the Architect.

3.11 POINT CHARTS

A. The Contractor shall be responsible to define, describe and identify all required points to support the system and provide such charts or print-outs developed listing all points as part of prefabrication submittals.

END OF SECTION 280000

SECTION 28 31 00 - ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary conditions and Division-1 specification sections, apply to work of this section.

B. Division 26, Basic Electrical Materials & Methods apply to work specified in this section.

C. Division 26 “Electrical Identification” apply to work in this section for labeling of conduit and equipment.

D. Related work specified in other divisions of these specifications.

1. Installation of duct type smoke detectors.
2. Control wiring from Fire Alarm Control equipment to mechanical fans, dampers, control equipment both low voltage and line voltage and all other control wiring associated with mechanical equipment.

E. Secure permits and approvals prior to installation.

F. Prior to commencement and after completion of work notify Authorities Having Jurisdiction.

G. Submit letter of approval for installation before requesting acceptance of system.

1.2 SUMMARY

A. Provide a complete and coordinated Class A wiring, fire management system in accordance with the contract documents. The existing system is Simplex. All new equipment shall be provided by Simplex. The existing system shall be modified and augmented as required. Retain services of Marc DeMattos at Simplex:

Marc DeMattos
12 Jeanne Drive
Newburgh, NY 12550
Office 845-566-0533
Fax 845-566-1978
Cell 845-791-0262

B. Any fire alarm devices, wiring etc., not indicated on the drawings, but required by the Authority Having Jurisdiction and Fire Department, shall be provided as part of this specification. As minimum, an additional 1 audio/visual alarms 1 smoke detectors and 2 addressable interface devices shall be included in price including labor, circuitry and programming. Devices shall be placed as directed in field.

1.3 RELATED WORK

A. The Contractor shall coordinate work in this Section with all related trades. Work and/or equipment provided in other Sections and related to the alarm system shall include, but not be limited to:

1. Fire/Smoke Dampers wiring and connections shall be provided under this contract. Refer to mechanical drawings for quantities and locations.
2. Duct smoke detectors shall be furnished, wired and connected by the electrical contractor. The HVAC contractor shall furnish necessary duct opening to install the duct smoke detectors.
3. Conduit: Section 26 05 33.
4. Wire and Cables: Section 26 05 13.

1.4 SUBMITTALS

A. Procedure - prepare and make submittals listed in accordance with Division 1, “Submittals” as required by Local Department of Fire.

B. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer’s part number, the description of the part, and the part number of the manufacturer’s product datasheet on which the information can be found.

C. Provide description of operation of the system (Sequence of Operation), similar to that provided in Part 2 of this Section of the Specifications, to include any and all exceptions, variances or substitutions listed at the time of bid. Any such exceptions, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. The sequence of operation shall be project specific, and shall provide individual sequences for every type of alarm, supervisory, or trouble condition that may occur as part of normal or off-normal system use.

D. Product Data - submit manufacturer’s specifications, recommendations, and installation instruction for use intended. The data shall include but is not limited to the following:

1. Smoke sensors
2. Installer’s training history
3. Visual alarms
4. Audio/visual alarms
5. Addressable interface devices
6. Wiring conductors
7. Wire connectors
8. Manufacturer’s recommended calibrated test method for smoke sensors and smoke detectors.
9. Include Underwriters Laboratories or Factory Mutual listing cards for equipment provided.

E. Provide manufacturer’s printed product data, catalog cuts and description of any special installation procedures. Poorly photocopied and/or illegible product data sheets shall not be acceptable and shall be rejected. All product datasheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.

F. Provide manufacturer’s operator’s instruction manual for specified system.

G. Provide samples of various items when requested.

H. Provide copy of New York State License to perform such work.

I. Provide copies of NICET Level II Fire Alarm certifications for the two (2) technicians assigned to this project.

J. Drawings

1. Detailed drawings for the fire alarm system shall consist of illustrations, schedules, performance charts, battery calculations, point lists, instructions, diagrams, sequence of operation, and complete detailed drawings of the fire alarm system.
2. A descriptive index of drawings in the submittal with drawings listed in sequence by drawing number.
3. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
4. Floor plans drawn to a scale not less than 1/8-inch equals 1 foot which clearly show locations of devices, equipment, risers, panels, electrical power connections, approximate location of conduit runs, and other details required to clearly describe the proposed system.
5. Location of control panels, detectors, supervisory switches, manual pull stations, visual/audible alarms and electrical devices. Clearly and completely indicate the function of the control panel and devices. Indicate conduit routing and sizes, and the number of conductors contained in each. Indicate points of connection and terminals used for electrical field connections in the system, with a wiring color code. Indicate termination points of devices and indicate the interconnection of modules required for proper operation of the system. Indicate interconnection between modules and devices. Control diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate control panel wiring and make and model of devices and equipment. Signal circuit diagrams shall show current draw and load by device and by circuit.
6. Device riser diagram shall individually depict all control panels, annunciators, addressable devices, and notification appliances. Riser diagrams shall include a specific, proposed point descriptor above each addressable device. Riser diagrams shall include a specific, discrete point address that shall correspond to addresses depicted on the device layout floor plans. Drawing shall provide wire specifications, and wire tags shown on all conductors depicted on the riser diagram. All circuits shall have designations that shall correspond with those require on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.
7. Device typical wiring diagram drawing(s) shall be provided which depict all system components, and their respective field wiring termination points. Wire type, gauge, and jacket shall also be indicated. When an addressable module is used in multiple configurations for monitoring or controlling various types of equipment, different device typical diagrams shall be provided. End-of-line resistors (and values) shall be depicted.

K. Field Test Reports

1. Preliminary and acceptance tests.
2. Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include printer information.

L. Records Drawings

1. Upon completion, and before final acceptance of the work, submit a complete set of CAD generated as-built drawings for the fire alarm system, including components and any

other associated appurtenances. Include as-built circuit diagrams complete with conductor color codes and a listing of initiating device locations and fixing voltage for each. Submit (3)full size hard copies and a set of PDF as-built drawings with title block similar to contractor drawings of entire project. Submit as-built drawings in addition to the record drawings required by Division 1, "Operation and Maintenance Data".

2. List of FACP alphanumeric address names
3. Request for formal inspection and tests
4. When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests.

M. Operation and Maintenance Manuals

1. Smoke and thermal sensors
2. Interface and control modules
3. Submit in accordance with Division 1, "Operation and Maintenance Data". Include current unit prices and source of supply for parts list, and a list of parts recommended by the manufacturer to be replaced after one year and three years of service. Include in the fire alarm control panel, full and comprehensive manufacturer's repair and service manuals.

N. See section 3.3 F. Documentation and Training for other documents related to this section.

1.5 QUALITY ASSURANCE

A. Qualifications the manufacturer's authorized distributor must substantiate that within a 50 mile radius of the job site, there is an established agency which stocks a full complement of parts and offers full service during normal working hours on all equipment to be furnished and that the agency will supply parts without delay and at a reasonable cost.

B. Qualifications of Installer: Prior to installation, submit data for approval showing that the Contractor has successfully installed addressable, analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

C. Codes and Standards: Except as modified by governing codes and where more stringent standards are specified by the contract documents, comply with the latest applicable provisions and the latest recommendations of the following:

1. All equipment shall be UL listed for its intended use.
2. National Electric Code, Article 760.
3. National Fire Protection Association Standards: NFPA72 and NFPA 101.
4. Local and State Building Codes and the Local Authorities Having Jurisdiction.
5. MEA / BSA
6. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:
   UL 864/UOJZ, APOU Control Units for Fire Protective Signaling Systems.
   UL 268 Smoke Detectors for Fire Protective Signaling Systems.
   UL 268A Smoke Detectors for Duct Applications.

UL 217 Smoke Detectors Single Station.
UL 521 Heat Detectors for Fire Protective Signaling Systems.
UL 228 Door Holders for Fire Protective Signaling Systems.
UL 464 Audible Signaling Appliances.
UL 1638 Visual Signaling Appliances.
UL 38 Manually Activated Signaling Boxes.
UL 346 Waterflow Indicators for Fire Protective Signaling Systems.
UL 1971 Standard for Signaling Devices for the Hearing Impaired
UL 1481 Power Supplies for Fire Protective Signaling Systems.
UL 1711 Amplifiers for Fire Protective Signaling Systems.

7. Americans with Disabilities Act (ADA)
8. International Standards Organization (ISO): ISO-9001
9. Local and City Codes.

D. Federal Specifications Compliance: Comply with FED-STD-595, “Colors used in Government Procurement”.

E. Guarantee - all components, parts and assemblies supplied by the manufacturer shall be guaranteed against defects in materials and workmanship for a period of 12 months upon acceptance. Warranty service shall be provided by a trained specialist of the equipment manufacturer. The specialist shall be based in a fully-staffed branch office located within 50 miles from the job site.

F. Testing - conduct a total system test for Architect/Engineer and Local Fire Department. Tests shall include as a minimum.

1. Verify operation of all manual pull stations and detectors.
2. Verify line supervision of each initiating and indicating circuit.
3. Verify the Class A operation of each initiating circuit.
4. Verify operation of all indicating devices.
5. Verify operation of all alarm initiated function.
6. Perform smoke test(s) as directed by the Local Fire Department. Provide electricians, and factory representatives to perform as many tests as required to approve system. The Engineer, Owner and Architect shall be advised a minimum of five working days before each test.

G. All equipment provided as part of this section shall be the product of a single fire alarm equipment manufacturer.

H. Equipment and devices shall be from a manufacturer who has been manufacturing similar products for a minimum of 5 years. Furnish materials and equipment that are current products of one manufacturer regularly engaged in the production of such equipment.

I. Regulatory Requirements

1. Devices and equipment for fire alarm service shall be listed by Underwriters Laboratories, Inc. and listed in UL FPKD or approved by Factory Mutual and listed in FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

J. Requirements for Fire Protection Service

1. Equipment and material shall have been tested by Underwriters Laboratories, Inc. and listed in UL FPKD or approved by Factory Mutual and listed in FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

K. Standard Products

1. Materials and equipment shall be standard new products of a manufacturer regularly engaged in the manufacturer of such products. Select material from one manufacturer, and not a combination of manufacturers, for any particular classification of materials.

L. Modification of References

1. In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word “shall” had been substituted for “should” wherever it appears; interpret reference to “authority having jurisdiction”.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect equipment delivered and placed in storage from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

PART 2 - PRODUCTS

2.1 SYSTEM DESIGN

A. Acceptable Manufacturers:

1. Simplex.
2. All products used shall be of a single manufacturer. Submission of notification appliances, auxiliary relays, or documentation from other than a single manufacturer shall not be acceptable and will be grounds for immediate disapproval without comment.
3. The Fire Alarm System supplied under this specification shall be a microprocessor-based. All Control Panel Assemblies and connected Field Appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as compatible to ensure that a fully functioning Life Safety System is designed and installed.

B. Scope :

1. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performing all operations in connection with the installation of the multiplex addressable Fire Alarm System (Class A) as shown on the drawings, as hereinafter specified, and as directed by the architect/engineer. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer. The system shall consist of, but not be limited to, the following:
   a. Addressable analog area smoke detectors.
   b. Addressable analog Photo-electric duct smoke detectors for supply fans over 2,000 cfm. Supply and return for fans over 15,000 cfm.

c. Damper control with duct detector for each FSM damper.
d. Air handling systems shutdown control.

2. The Fire Alarm System shall consist of all necessary hardware and software equipment to perform the following functions:
   a. Fire Alarm and Detection Operations.
   b. Interface to Division 23 smoke control equipment with appropriate outputs, controls and graphics.
3. Each item of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by the Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. The Control Equipment for all Systems shall be listed under UL category UOJZ as a Single Control Unit.
4. The complete installation shall conform to the applicable sections of NFPA-72, NEC 76, Life Safety Code 101, and Local authorities having jurisdiction.
5. Nodes as defined for this specification shall be intelligent, microprocessor based devices that connect to, and handle network communications.
6. By programmable selection at each node:
   a. The specific detail information of any point connected to any node in the network may be made accessible (declared public) to the network.
   b. Points within each node shall be able to be grouped by area, type of device, type of function, or any other user selectable category, and custom labeled as a point list. A point list shall be acted upon as though it was a point for purposes of interaction with the node custom control program. Detail information shall not burden the point list messages, only the quantity and type of status shall be broadcast into the network.
7. Survivability: When wiring connecting the FSCS to any remote mounted controlling device exceeds 100 feet; the wire shall be 2-hour rated in addition to being in conduit.
8. All locally required Fire Alarm system peripherals, placards, pull station white stripe plate, riser diagram, etc. shall be included in the system price.

C. Alarm System

1. Furnish and install a fully field programmable/addressable analog fire detection system. The System shall determine the number and types of modules installed, the number of analog addressable loops, and all installed devices. It shall determine the type of device and the device number. The System shall use Style 4 (Class A) signaling line circuits and Style Z (Class A) indicating appliance circuits with individual device supervision and annunciation, primary and secondary supervision, and interfaces to the public address system (furnished by others). Include signal zone selectors, manual pull stations, smoke sensors, thermal sensors, addressable input interface devices, control and isolation devices, analog/addressable loop modules, audio/visual devices, visual devices, wiring, connections to devices, outlet boxes, junction boxes, and other necessary material for a complete operating system. System shall allow for loading or editing special instructions and operation sequences as required. System shall be site programmable to accommodate and facilitate expansion or changes. System shall be capable of generating the programming necessary to establish a fully functional general alarm system upon initialization. Software operations are to be stored in a non-volatile programmable memory. Loss of primary and secondary power shall not erase the instructions stored in memory. Selective input/output control functions based on ANDing, Oring, NOTing, timing and special coded operations shall be incorporated in the resident software programming of the system.

D. Job Site Changes

1. To accommodate and facilitate job site changes, initiating and indicating circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit or an alarm verification circuit.

E. Operations

1. Refer to sequence of operations on drawings.

F. Wiring

1. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class A operation.
2. Where it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class A zone wiring.
3. Each of the following types of alarm notification appliances shall be circuited as shown on the drawings but shall be typically as follows:
   a. Audible Signals: Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.).
   b. Visual Signals Provide sufficient spare capacity to assure that the addition of three (3) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.).
4. Each of the following types of remote equipment associated with the alarm system shall be provided with a form ‘C’ control relay contact as shown on the drawings, but shall be typically as follows:
   a. HVAC Fan Systems: Provide one (1) shutdown control relay contact for each HVAC fan system.
   b. HVAC Supply Fans: Provide one (1) shutdown control relay contact for each HVAC supply fan.
   c. HVAC Return Fans: Provide one (1) shutdown control relay contact for each HVAC return fan.
5. Provide a dedicated 24VDC circuit to feed all auxiliary relays required for inductive loads. Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.

2.2 COMPONENT DESIGN

A. Colors

1. Provide finish colors under this section in accordance with FED-STD-595.

B. Intelligent Devices—General

1. Each remote device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required for its functionality the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector

sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller.

2. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and *supervision by location.* Setting a device's address by physical means shall not be necessary.

C. Intelligent Detectors—General

1. The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable.

2. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total analog loop response time for detectors changing state shall be 0.5 seconds.

3. Each detector shall have a separate means of displaying communication and alarm status. A green LED shall flash to confirm communication with the analog loop controller. A red LED shall flash to display alarm status.

4. The detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

5. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.

6. Each detector microprocessor shall contain an environmental compensation algorithm which identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminates as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long term and 4 hour short term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.

7. The intelligent analog detectors shall be suitable for mounting on any detector mounting base.

D. Photoelectric Smoke Detector

1. Provide intelligent photoelectric smoke detectors. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples

from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.

2. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

   - Temperature: 32^{O}F to 120^{O}F (0^{O}C to 49^{O}C)
   - Humidity: 0-93% RH, non-condensing
   - Elevation: no limit

E. Standard Detector Mounting Bases

Provide standard detector mounting bases suitable for mounting on North American 1-gang, 3½" or 4" octagon box and 4" square box. The base shall, contain no electronics, support all detector types and have the following minimum requirements:

1. Removal of the respective detector shall not affect communications with other detectors.
2. Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.
3. The base shall be capable of supporting one (1) Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

F. Duct Detector

Provide low profile intelligent addressable duct smoke detector as indicated on the project plans. Provide for variations in duct air velocity between 100 and 4,000 feet per minute and include a wide sensitivity range of .79 to 2.46%/ft. obscuration. Include one Form-C shut down relay rated 2.0 amps @ 30 Vdc and also include slave high contact relays if required. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. The addressable DUCT housing shall be suitable for extreme environments, including a temperature range of –20 to 158 degrees F (-29 to 70 degrees Celsius) and offer a harsh environment gasket option. Provide Remote Alarm LED Indicators and/or remote test station model as indicated on the project plans.

G. Intelligent Modules—General

It shall be possible to address each module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash

to display alarm status. The module shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:

- Temperature: 32^{O}F to 120^{O}F (0^{O}C to 49^{O}C)
- Humidity: 0-93% RH, non-condensing

H. Single Input Module

Provide single input modules. The Single Input Module shall provide one (1) supervised Class A input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types:

- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
- Normally-Open Alarm Delayed Latching (Waterflow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches)

I. Dual Input Module

The Dual Input Module shall provide two (2) supervised Class A input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types:

- Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
- Normally-Open Alarm Delayed Latching (Waterflow Switches)
- Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.)
- Normally-Open Active Latching (Supervisory, Tamper Switches)

J. Monitor modules

The Monitor Module shall be factory set to support one (1) supervised Class A Normally-Open Active Non-Latching Monitor circuit. The monitor module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.

K. Single Input Signal Module

Provide single input signal modules. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class A output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The single input signal module shall support the following operations:

- Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio)

L. Control Relay Module

Provide control relay modules. The Control Relay Module shall provide one form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers.

M. Remote Relays, Multi-Voltage Control Relays

Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

N. Multi-Voltage Control Relays

Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

O. Notification Appliances – General

1. All appliances shall be UL Listed for Fire Protective Service.
2. All strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act accessibly guidelines (ADA(AG)), and shall be UL 1971, and ULC S526 Listed.
3. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel (NO EXCEPTIONS) specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers' instructions.
4. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from THE CONTROL PANEL MANUFACTURER clearly stating that the control equipment (as submitted) is 100% compatible with the submitted Notification Appliances.

P. Strobes

Provide low profile wall mounted strobes at the locations shown on the drawings. Strobes shall provide synchronized flash outputs. Strobe output shall be field selectable as indicated on the drawings in one of the following intensity levels; 15cd, 30cd, 75cd or 110cd. Low profile strobes shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.

Q. Speakers and Speaker Strobes

Provide low profile wall mount speaker/strobes at speakers with a 4” mylar cone as manufactured by EST, Cat. No. Genesis Series. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. In - Out screw terminals shall be provided for wiring. Speaker housings shall be red. Speakers shall be provided for use with 70V systems. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speakers shall mount in a North American 4” electrical box with extension ring using the 2 screws provided with ring. It must not be necessary to completely remove the screws to facilitate mounting. provided with box or to a 2-gang (2-3/4” deep) electric box. Speakers with a strobe, the output shall be field selectable as indicated on the drawings in one of the following intensity levels; 15cd, 30cd, 75cd or 110cd.

R. Operating Instruction/Riser Diagram Holders

Shall be red painted steel, frame holder with clear, Acrylic window with nine inch by twelve inch (9” x 12”) dimensions. One (1) holder shall be provided for the fire alarm control panel FACP)/system operating instructions and one (1) holder shall be provided for a reduced copy (8-1/2” X 11”) of the fire alarm system riser diagram. The operating instruction and riser diagram holders shall be mounted adjacent to the fire alarm control panel (FACP).

S. STI Stopper II Lexan Guards

Manual pull stations that are provided with STI Stopper II lexan guards shall include non-audible alarms as required on the plans. They shall be surface or flush mounting, as required for each individual device.

2.3 SUPPORT FOR INSTALLER AND OWNER MAINTENANCE

A. Provide a coded one-man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.

B. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.

C. Provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.

D. Allow the user to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the user with a measure of contamination of a device upon which cleaning decisions can confidently be made.

E. Allow the user to report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.

F. Allow the user to disable/enable devices, zones, actions, timers and sequences. Protect the disable function with a password.

G. Allow the user to activate/restore outputs, actions, sequences, and simulate detector smoke levels.

H. Allow the service user to enter time and date, reconfigure an external port for download programming, initiate auto programming and change passwords. Protect these functions with a password.

I. THE END-USER SHALL RETAIN COMPLETE RIGHTS AND OWNERSHIP TO ALL SOFTWARE RUNNING IN THE SYSTEM. The alarm equipment vendor shall provide useable hard and soft copies of the software database to the End-User at the end of the warranty period. The database provided shall be useable by any authorized and certified distributor of the product line, and shall include all applicable passwords necessary for total and unrestricted use and modification of the database. The Consulting Engineer shall define the extent of hardcopy database documentation to be provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer's wiring diagram. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the manufacturer, approved by the local Fire Department and specified within.

B. All penetration of floor slabs and firewalls shall be sleeved (1" conduit minimum) fire stopped in accordance with all local fire codes.

C. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.

D. All manual pull stations shall be mounted 48 inches above the finished floor, as measured to the handle.

E. All audio/visual devices shall be mounted 80 inches above the finished floor, as measured on center. Devices shall be mounted no less than 6 inches from the ceiling. All audiovisual devices shall have lexan covers in all areas.

F. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.

G. No area smoke or heat detector shall be mounted within 12 inches of any wall. All detectors shall be installed in strict accordance with NFPA 72.

H. All areas in public view shall be in metal conduit. All boxes must be painted red and labeled.

I. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.

J. All low voltage wiring terminated to the fire alarm system shall be PLENUM RATED with no exceptions and no less than No. 12 AWG in size for NAC circuits and 16 AWG for Initiating Circuits, and solid copper.

K. All fire alarm wiring shall be armored fire alarm cable.

L. All line voltage (120VAC) wiring shall be no less than No. 12 AWG in size, and solid copper. This shall include all system grounding.

M. All wiring shall be color-coded throughout, to National Electrical Code standards.

N. Power-limited/Non-power-limited NEC wiring standards SHALL BE OBSERVED.

O. All junction box covers shall be painted red and labeled INTERIOR FIRE ALARM SYSTEM.

P. Fire alarm system wiring shall not co-mingle with any other system wiring in the facility. Conduits shall not be shared under any circumstance. Only when fire alarm wiring enters the enclosure of a monitored or controlled system will co-habitation be permitted (i.e. at fan starters or elevator controllers). THIS WILL BE FIELD INSPECTED BY THE PROJECT ENGINEER.

Q. Fire alarm control panel enclosures shall have engraved labels indicating, “FIRE ALARM SYSTEM”, and the areas of the building served by that panel.

R. Auxiliary relays shall be appropriately labeled to indicate “FIRE ALARM SYSTEM” and their specific function (i.e. FAN S-1 SHUTDOWN).

S. All fire alarm wiring shall be continuous and unspliced. Terminations shall only occur at fire alarm devices or control panel enclosures under terminal screws. All other splicing methods are specifically disallowed (i.e. plastic wirenuts).

T. All alarm wiring shall be installed using a dedicated system of supports. Fire alarm wiring shall not be bundled or strapped to existing conduit, pipe or wire in the facility. THIS WILL BE FIELD INSPECTED BY THE PROJECT ENGINEER.

U. All alarm wiring shall be sleeved when passing through any wall, using conduit sleeves (1” min.) with bushings, and fire stopped in accordance with Code.

V. The system shall be arranged to receive power from one three wire 120 Vac, 20 A supply. All low voltage operation shall be provided from the fire alarm control panel.

W. All alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the Contract Drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer. Failure to bring such issues to the attention of the Project Engineer shall be the exclusive liability of the installing Electrical Contractor.

X. The installing Electrical Contractor shall be responsible for the removal of ENTIRE existing alarm system components and controls on the demolition drawing shown or not, upon approval of the AHJ and the Consulting Engineer. The End-User reserves the right to retain any existing alarm system components, upon their request. All existing alarm system components requiring special handling for disposal (due to radioactivity) shall be the responsibility of the installing contractor. Written proof of proper disposal by the installing contractor shall be required prior to release of outstanding retainage.

Y. The existing fire alarm system shall remain in operation until such time that approval has been granted for its removal. The installing Electrical Contractor shall be responsible for the upkeep of the existing system until such time that it can be removed.

3.2 PAINTING

A. Paint exposed electrical, fire alarm conduit and surface metal raceway to match adjacent finishes in exposed areas. Paint conduit and surface metal raceways red in unfinished areas and above finished ceilings.

3.3 FIELD QUALITY CONTROL

A. The system shall be installed and fully tested under the supervision of a trained manufacturer's representative. The system shall be demonstrated to perform all of the function as specified.

B. The installing contractor or fire alarm equipment vendor shall have no less than two (2) NICET Level II fire alarm technicians dedicated to this project.

C. The Installing Contract and the Alarm System Vendor shall, upon the request of the Consulting Engineer or End-User, attend any and all project meetings for the purpose of accurately determining progress.

D. It shall be the responsibility of the installing contractor to assure that construction debris does not adversely affect any sensing devices installed as part of this project. Should it be deemed necessary by the Consulting Engineer, End-User or AHJ, the installing contractor shall be responsible for the cleaning of all smoke detectors prior to final acceptance.

E. Preliminary Tests

1. Conduct the following tests during installation of wiring and system components. Correct any deficiencies pertaining to these requirements prior to formal functional and operational tests of the system.
2. Ground Resistance
   a. Measure the resistance of each connection to ground. Ground resistance shall not exceed 10 ohms.
3. Dielectric Strength and Insulation Resistance
   a. Test dielectric strength and the insulation resistance of system interconnecting wiring by means of an instrument capable of generating 500 volts dc and equipped to indicate leakage current in 1000 mega-ohms. For the purpose of this test, instrument shall be connected between each conductor on the line and between each conductor and ground at control panel and of line, with the other extremity open circuited and series-connected devices shunted or in place. System shall withstand test without breakdown and indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than 1.0 minute with a dc potential of not less than 100 volts nor more than 550 volts. Dielectric tests shall be witnessed by Engineer or his designee.
4. Smoke and Thermal Sensor Tests
   a. Prior to formal inspection and tests, clean and perform sensitivity tests on each smoke and thermal sensor. Clean the smoke and thermal sensors in accordance with the manufacturer's recommended procedures. Perform voltage activation sensitivity test on each sensor and record the results. Remove sensors with a sensitivity level above or below the UL accepted sensitivity range for that sensor and replace with new sensors. Present recorded data at the formal inspection for verification. Approved copies shall become part of the operations and maintenance manual for the fire alarm system.
5. Field Inspection and Test
   a. Before final acceptance of the work, test each system to demonstrate compliance with the contract requirement. Each system shall be subjected, at minimum, to complete functional and operational tests including tests in place of each smoke sensor and detector, each thermal sensor, each manual station and visual and audio/visual device, tests of wiring supervision and tests of control panel functions. Test the interface to the Public Address system and coordinate the P.A. alarm signal generation with the public address system subcontractor. Preliminary tests shall be performed in accordance with manufacturer's published testing instructions and in accordance with NFPA 72. Furnish one extra Operations and

Maintenance Manual with the formal request for final acceptance testing. The system shall be operational, with no trouble or alarm conditions, a minimum of 14 consecutive days prior to formal tests. Printer shall be operational during the preliminary tests and break-in period. Provide printer records with the request for formal inspection as evidence of completion of required preliminary test.

6. Formal Inspection and Test
   a. The Authority having Jurisdiction will witness formal tests after receipt of written certification that preliminary tests have been completed and that the system is ready for final inspection. The system manufacturer's technical representative shall be present for the inspection and test. At minimum, preliminary tests shall be repeated and functional and operation tests conducted, as requested by the Architect/Engineer. Correct defects and conduct additional tests to demonstrate that the system conforms to contract specifications. Contractor shall provide two-way radios, personnel and test equipment required for conducting tests. Smoke detectors shall be tested using the manufacturer's calibrated test method. In addition, formal testing will require real smoke to be used to test smoke detectors. Canned smoke will not be permitted. Test equipment shall be turned over to the Authority having Jurisdiction following test completion.
7. Manufacturer's Field Service
   a. Manufacturer's Representative
      Furnish the services of a factory-trained fire alarm system manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided, to supervise the installation, testing, including formal testing, adjustment of the system, and instruction to the facility personnel. Furnish names and phone numbers of the factory-trained fire alarm system representatives or technicians.

F. Documentation

1. The contractor shall compile and provide to the owners three (3) complete manual on the completed system to include SITE SPECIFIC operating and maintenance instruction, catalog cuts of all equipment and components, as-built wiring diagrams and a manufacturer's suggested spare parts list.
2. As-built drawings shall consist of the following:
   a. Complete revision of all previously submitted drawings
   b. Point-to-point depiction of all device wiring on the device layout floor plans.
   c. PDF copies of as-built drawings.
   d. Two (2) sets of full size drawing showing all points of alarm. One set shall be submitted with the close-out documents. Second set shall be mounted in frame with a lexan cover. These drawing must be submitted to project Engineer or approval.
3. Turnover of all software database hard/soft copies shall be required. This shall include all possible programming software logs or CDs containing exported project files, hard copies of all device maps, the revision number of the version of programming utility used, and all required passwords. The turnover of all database information shall occur prior to the end of the One (1) warranty period (or period as amended earlier in this specification).

G. Adjustments

1. Equipment manufacturer shall provide necessary subsequent custom reprogramming to modify and adjust operations and individual identification nomenclature to the owner

satisfaction four months after final system acceptance and twelve months after system acceptance. Reprogramming is to be done at the job site and witnessed by the Authority having Jurisdiction representative. Revision of as-built and record drawings shall be by the installing Contractor.

END OF SECTION 283100