ADDENDUM NO. 5, JANUARY 7, 2003

RE: Clearfield DWS-DHS Connection &
2nd Floor Build-out
1350 East 1450 South
Clearfield, Utah
DFCM Project No. 02204920

FROM: EFT Architects, a 3D/International Group
265 East, 100 South, Suite 350
Salt Lake City, Utah, 84111
(801) 521-8564

TO: Prospective Bidders

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated November 12, 2002, as noted below. Acknowledge receipt of this Addendum in the space provided on the Proposal. Failure to do so may subject Bidder to disqualification.

This Addendum consists of 866 pages including [2] 8-1/2" x 11" written instructions, [768] 8-1/2" x 11" specifications, [32] 8-1/2" x 11" supplementary conditions and [64] 24"x 36" drawings.

GENERAL

This addendum includes all previous drawing and specification addenda changes.

In order to modify the drawings and specifications to accommodate the revisions to this project and minimize potential conflicts, we are reissuing the complete Contract Documents for this revised bid.

Addendum No. 5 will replace drawings and specifications as indicated below. All other drawing changes, included in this addendum, are indicated with clouded areas.

Drawings not clouded or replaced, as indicated below, shall remain as modified by the previous addenda.

All previous DHS roofing issues shall be disregarded. This issue has been nullified due to the change of roof heights. For more information, please refer to the specification section of this Addendum.

The following changes have been made to the specifications:

Table of Contents – Under Division 7 – THERMAL AND MOISTURE PROTECTION, add "07412 METAL WALL PANELS."

Section 03300 "Cast In Place Concrete" – Delete paragraphs associated with lightweight concrete and associated materials.

Section 05310 “Steel Deck” – Delete paragraphs associated with composite floor deck and associated materials.

Section 07210 “Building Insulation” – Delete subparagraph 2.2.B.2, and paragraph 3.5.C specifying insulation at Z-furring.

Add Section 07412 “Metal Panels”
Section 09260 “Gypsum Board Assemblies” – Delete paragraph 2.3.D, paragraph 3.2.E, and subparagraph 3.6.A.3 specifying Z-furring.

Section 15010 “General Provisions” – add Prior Approvals to Products Section.

The following are drawing sheets that have been replaced:

AE103
AE110A
AE201
AE211
AE501
AE502
AE611
AE701
EP103

END OF ADDENDUM NO. 5

January 6, 2003

Farley Engineering
Doug Farley
1917 E. Osage Orange Ave.
Holladay, UT 84124
(801) 274-3151 Fax (801) 274-3150

Re: **Evaluation of Openweb Trusses**
DHS Building – Clearfield, UT

Dear Doug,

This letter is written in response to the issue of proposed load changes to the Open Web trusses in the DHS Building. According to the information provided to Trus Joist, the owner would like to add a parapet wall that will add new snowdrifts to the existing structure.

The affected area consists of parallel profile TJL trusses with a depth of 34" and a span of 27 feet. The original design loads were 22.75 PSF dead and 28 PSF live with a load duration factor of 115%. Per your instructions, the dead load has been reduced to 12 PSF with the removal of the ballast roof system. The additional load to be applied to the truss is a 28 PSF to 0 PSF tapered drift load with a length of 7.56 feet.

Using the new application loads, the trusses can safely support the new drift load as specified. A new truss calculation will be included with this letter.

The trusses are assumed to be in their original as-built condition, with no damage or defects due to installation, remodel, abuse, or decay. Trus Joist has made no analysis of any modifications to the building other than those listed above. Any new lateral load analysis and connections are the responsibility of the project design professional. Trus Joist has not been retained to provide inspection of the completed modification.

If we can be of further assistance in this matter, please feel free to contact us.

Sincerely,

Rex Flegel
TJ Repair Group – Boise, ID

cc: Curt Mathews
(enclosure)

PROJECT MANUAL

CLEARFIELD DWS-DHS CONNECTION
& 2ND FLOOR BUILD-OUT
CLEARFIELD, UTAH

STATE OF UTAH
DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
DFCM PROJECT NO. 02204920
NOVEMBER 12, 2002

EFT

PROJECT MANUAL

For

Department of Workforce Services
CLEARFIELD DWS-DHS CONNECTION
& 2ND FLOOR BUILD-OUT
CLEARFIELD, UTAH
DFCM PROJECT NO.: 02204920

Approvals:

David Mckay — 11-8-02
David Mckay — Date
Program Director, DFCM

Gary M Adams — Nov. 8, 2002
Gary M. Adams — Date
Facilities Planner
Department of Workforce Services

CLEARFIELD DWS-DHS CONNECTION
& 2ND FLOOR BUILD-OUT
CLEARFIELD, UTAH

DFCM PROJECT NO.
02204920

PROFESSIONAL SEALS

STATE OF UTAH
STEPHEN
ENGINEER
No. 1094
LICENSED ARCHITECT
NOV. 8, 2002

ARCHITECTURAL

STRUCTURAL

LICENSED PROFESSIONAL ENGINEER
DOUGLAS
M. FARLEY
No. 318331
11/8/02
STATE OF UTAH

REGISTERED PROFESSIONAL ENGINEER
#117077
WAYNE CLARK
PETERSON
STATE OF UTAH

MECHANICAL

ELECTRICAL

LICENSED PROFESSIONAL ENGINEER
No. 374952
CHAD B.
FORREST
11/08/02
STATE OF UTAH

TABLE OF CONTENTS

APPROVALS
PROFESSIONAL SEALS
TABLE OF CONTENTS

SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

01100 SUMMARY
01140 WORK RESTRICTIONS
01230 ALTERNATES
01250 CONTRACT MODIFICATION PROCEDURES
01290 PAYMENT PROCEDURES
01310 PROJECT MANAGEMENT AND COORDINATION
01320 CONSTRUCTION PROGRESS DOCUMENTATION
01330 SUBMITTAL PROCEDURES
01400 QUALITY REQUIREMENTS
01420 REFERENCES
01500 TEMPORARY FACILITIES AND CONTROLS
01600 PRODUCT REQUIREMENTS
01700 EXECUTION REQUIREMENTS
01731 CUTTING AND PATCHING
01732 SELECTIVE DEMOLITION`
01770 CLOSEOUT PROCEDURES

DIVISION 2 - SITE CONSTRUCTION

02230 SITE CLEARING
02300 EARTHWORK
02751 CEMENT CONCRETE PAVEMENT
02764 PAVEMENT JOINT SEALANTS

DIVISION 3 – CONCRETE

03300 CAST-IN-PLACE CONCRETE

DIVISION 4 – MASONRY

04810 UNIT MASONRY ASSEMBLIES

DIVISION 5 – METALS

05120 STRUCTURAL STEEL
05210 STEEL JOISTS
05310 STEEL DECK
05400 COLD-FORMED METAL FRAMING
05500 METAL FABRICATIONS
05521 PIPE AND TUBE RAILINGS
05580 FORMED-METAL FABRICATIONS

05811 ARCHITECTURAL JOINT SYSTEMS

DIVISION 6 - WOOD AND PLASTICS

06100 ROUGH CARPENTRY
06402 INTERIOR ARCHITECTURAL WOODWORK

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

07210 BUILDING INSULATION
07411 METAL ROOF PANELS
07531 EPDM SINGLE-PLY MEMBRANE ROOFING
07620 SHEET METAL FLASHING AND TRIM
07841 THROUGH-PENETRATION FIRESTOP SYSTEMS
07920 JOINT SEALANTS

DIVISION 8 - DOORS AND WINDOWS

08111 STEEL DOORS AND FRAMES
08211 FLUSH WOOD DOORS
08411 ALUMINUM ENTRANCES AND STOREFRONTS
08711 DOOR HARDWARE
08716 AUTOMATIC DOOR OPERATORS
08800 GLAZING
08911 GLAZED ALUMINUM CURTAIN WALLS

DIVISION 9 – FINISHES

09253 GYPSUM SHEATHING
09260 GYPSUM BOARD ASSEMBLIES
09310 CERAMIC TILE
09511 ACOUSTICAL PANEL CEILINGS
09653 RESILIENT WALL BASE AND ACCESSORIES
09680 CARPET (STATE CARPET CONTRACT)
09912 PAINTING

DIVISION 10 – SPECIALTIES

10101 VISUAL DISPLAY BOARDS
10155 TOILET COMPARTMENTS
10410 FREESTANDING SIGNS
10431 SIGNS
10520 FIRE-PROTECTION SPECIALTIES
10801 TOILET AND BATH ACCESSORIES

DIVISION 11 – EQUIPMENT

11132 PROJECTION SCREENS

DIVISION 12 – FURNISHINGS

12491 HORIZONTAL LOUVER BLINDS

12680 FOOT GRILLES

DIVISION 13 - SPECIAL CONSTRUCTION (NOT USED)

DIVISION 14 - CONVEYING SYSTEMS

14240 HYDRAULIC ELEVATORS

DIVISION 15 - MECHANICAL

15010 GENERAL PROVISIONS
15030 SYSTEM COMMISSIONING
15042 TESTING
15043 BALANCING
15050 BASIC MATERIALS & METHODS
15180 INSULATION
15400 PLUMBING
15500 FIRE PROTECTION
15700 HEATING COOLING
15800 AIR DISTRIBUTION
15900 AUTOMATIC TEMPERATURE CONTROLS

DIVISION 16 – ELECTRICAL

16050 BASIC ELECTRICAL MATERIALS AND METHODS
16060 GROUNDING AND BONDING
16071 SEISMIC CONTROLS FOR ELECTRICAL WORK
16075 ELECTRICAL IDENTIFICATION
16080 ELECTRICAL TESTING
16120 CONDUCTORS AND CABLES
16130 RACEWAYS AND BOXES
16139 CABLE TRAYS
16140 WIRING DEVICES
16140sch WIRING DEVICE SCHEDULE
16145 LIGHTING CONTROL DEVICES
16269 VARIABLE FREQUENCY CONTROLLERS
16410 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
16442 PANELBOARDS
16491 FUSES
16511 INTERIOR LIGHTING
16724 ACCESS CONTROL AND SECURITY SYSTEM
16660 FIRE ALARM

END TABLE OF CONTENTS

SECTION 01100 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Project consists of:

1. Project Location: 1350 East, 1450 North, Clearfield, Utah
2. Owner: State of Utah, Division of Facilities Construction and Management (DFCM).

B. Architect Identification: The Contract Documents, dated November 12, 2002, were prepared for the Project by EFT Architects, A 3D/International Group, 265 East, 100 South, Suite 350, Salt Lake City, Utah 84111.

C. The Work consists of construction of a new two-story connector/lobby between the existing Department of Human Services (DHS) Building and the Department of Workforce Services (DWS) Building, and build-out of the second floor shelled space in the Department of Workforce Services Building. Work also includes site improvements.

1. The Work includes steel frame construction on conventional spread/spot footings. Building exterior consists of brick veneer, aluminum curtain wall system, and single-ply roofing membrane. Interior work consists of interior finished spaces, including partitions, finishes, railing systems, doors and windows, casework, specialties, and hydraulic elevator installed in existing hoistway. The work also includes associated mechanical, plumbing, and electrical work.
2. Refer to Division 1 Section “Alternates” for alternate related to shelled space on second floor.

1.3 CONTRACT

A. Project will be constructed under a general construction contract.

1.4 WORK SEQUENCE

A. The Work shall be conducted in one phase.

1.5 WORK UNDER OTHER CONTRACTS

A. Separate Contract: Owner will award a separate contract for performance of certain construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract. This contract will include the following:

1. Communication equipment, data equipment, and associated wiring and devices.

B. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.6 FUTURE WORK

A. Future Contract: Owner will award a separate contract for additional work to be performed at the site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract. The Contract for future work will include the following:

1. Furnishings.

1.7 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may

be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

SECTION 01140 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Limits: Confine constructions operations to area indicated.
2. Owner Occupancy: Allow for Owner occupancy of buildings and use by the public.
3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, the public, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.3 OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy existing buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations.

B. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed.

On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of building.

4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01140

SECTION 01230 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Proposal for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost for each alternate is the net addition to the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Interior build-out of selected shelled space for DHS on second floor of existing DWS building. Refer to drawings requirements and location of selected area.

END OF SECTION 01230

SECTION 01250 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the 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 for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK (FIELD ORDER)

A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 14 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: For Change Order proposals, use forms provided by Owner.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on Owner’s standard form.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on Owner’s standard form. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01250

SECTION 01290 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the 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 necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

   a. Application for Payment forms with Continuation Sheets.
   b. Submittals Schedule.

2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

    a. Project name and location.
    b. Name of Architect.
    c. DFCM project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.

        1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Contractor's Agreement. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.

D. Transmittal: Submit 1 signed and notarized original copy, and 2 copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Preliminary Construction Schedule
4. Contractor's Construction Schedule (proposed).
5. Products list.
6. Schedule of unit prices (if applicable).
7. Submittals Schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Certificates of insurance and insurance policies.
11. Performance and payment bonds.
12. Data needed to acquire Owner's insurance.

F. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
3. See General Conditions Paragraph “Substantial Completion”.

G. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
3. Final, liquidated damages settlement statement.
4. See General Conditions Paragraph “Final Completion and Final Payment”.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings.
4. Administrative and supervisory personnel.
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
2. Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Refer to Division 15 and 16 for specific Coordination Drawing requirements for mechanical and electrical installations.

B. Staff Names: Within 14 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

A. General: Meetings and conferences will be conducted at Project site, unless otherwise indicated.

1. Attendees: Inform contractor's participants and individuals whose presence is required, of date and time of each meeting.

B. Preconstruction Conference: Owner will schedule and conduct a preconstruction conference before start of construction. Conference will be held at Project site or another convenient location. Meeting will be conducted to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Agenda will be provided by Owner.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related Change Orders.
d. Purchases.
e. Deliveries.
f. Submittals.
g. Review of mockups.
h. Possible conflicts.
i. Compatibility problems.

j. Time schedules.
k. Weather limitations.
l. Manufacturer's written recommendations.
m. Warranty requirements.
n. Compatibility of materials.
o. Acceptability of substrates.
p. Temporary facilities and controls.
q. Space and access limitations.
r. Regulations of authorities having jurisdiction.
s. Testing and inspecting requirements.
t. Required performance results.
u. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements.
4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Progress meetings will be conducted at weekly intervals, unless scheduled otherwise by Owner. Coordinate preparation of payment requests with dates of meetings.

1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Minutes of previous progress meetings will be reviewed and approved. Other items of significance that could affect progress will be reviewed. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.

8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Change Orders.
14) Documentation of information for payment requests.

c. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Field condition reports.
6. Special reports.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 1 Section "Submittal Procedures" for submitting schedules and reports.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

G. Major Area: A story of construction, a separate building, or a similar significant construction element.

H. Milestone: A key or critical point in time for reference or measurement.

I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article and in-house scheduling personnel 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.

B. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's final release or approval.

C. Preliminary Construction Schedule: Submit three copies.

D. Contractor's Construction Schedule: Submit three copies, large enough to show entire schedule for entire construction period.

E. Daily Construction Reports: Submit two copies at weekly intervals.

F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

G. Special Reports: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

   a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR’S CONSTRUCTION SCHEDULE AND CONTRACTOR’S PRELIMINARY CONSTRUCTION SCHEDULE

A. The work in this project shall be scheduled and progress monitored using a computerized critical path method (CPM) schedule, i.e. Primavera/Suretrak, provided by the Contractor.

B. The Contractor shall be responsible for planning and scheduling the work and monitoring progress of the work with respect to the schedule. The Contractor shall be responsible for scheduling all work activities, including those of their subcontractors and the Owner. The Contractor shall establish and maintain, as part of their organization a staff knowledgeable in the use and application of cost loaded (labor, equipment and time) CPM schedules.

C. The Owner and Architect will use all updated schedules in evaluation the progress of the Work and determining progress payments to be made to the Contractor. The computerized CPM Contractor's Construction Schedule, as updated twice per month, shall be the basis for determining the impact of changes to Contract delays.

D. Failure of the Contractor's Construction Schedule to include any element of the work required for the performance of this contract, or any inaccuracy in the Contractor's Construction Schedule, will not relieve the Contractor from his responsibility for accomplishing all the work required for a complete contract within the contract time and will not constitute grounds for delay.

E. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled date. Post copies in the temporary field office.

F. When revisions are made, distribute to the same parties and post in the same location. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

G. Construction Schedule Definitions:

1. "Contractor's Preliminary Construction Schedule" shall refer to the Schedule to be submitted by the Contractor within 7 days after Notice to Proceed. The Contractor's Preliminary Construction Schedule will be used to monitor progress of work for the first 60 days of the contract It shall also be the basis of the CPM Contractor's Construction Schedule.

2. "Contractor's Construction Schedule" shall refer to the schedule of the Contractor's plan of construction to be submitted by the Contractor for approval within 30 days after Notice to proceed, and implemented by the Owner and Architect.

2.3 CONTRACTOR'S PRELIMINARY CONSTRUCTION SCHEDULE

A. The Contractor shall submit the "Contractor's Preliminary Construction Schedule within seven days of Notice to Proceed.

B. The Contractor's Preliminary Construction Schedule shall be a feasible, workable, and reasonable schedule for their work, and it shall be the basis upon which the Contractor develops his construction Schedule (CPM). The Contractor's Preliminary Construction Schedule may be a Bar-Chart Schedule.

C. The first 60-day portion of the Contractor's Preliminary Construction Schedule shall be developed in sufficient detail to enable proper monitoring of work progress. The balance portion of the schedule leading to contract completion dates may be detailed or in a summary format.

D. The Contractor's Preliminary Construction Schedule shall be the basis for work to proceed and progress payment to be made for the first 60 days of the contract duration.

E. The Contractor's Preliminary Schedule shall take into account normal weather conditions to be expected in this area of Utah. No delay time will be awarded due to standard weather conditions.

F. Within 30 days after Notice to Proceed, the Contractor, shall prepare the proposed "Contractor's Construction Schedule", in computerized CPM format, and submit it ti the Owner and Architect for review.

G. Within 7 days thereafter, the Owner shall review the Contractor's proposed Contractor's Construction Schedule and provide comments and suggested changes and/or revisions.

H. Within 3 days thereafter, the Contractor shall resubmit the Contractor's revised Contractor's Construction Schedule after incorporating the necessary changes and revisions. Within 3 days after submittal, the Owner will reject or accept the Contractor's Construction Schedule. The Contractor must then resubmit within another 3 days, etc.

I. The Contractor shall certify that he accept the final version of the Contractor's Construction Schedule as a true representation of his plan of action and shall submit the following certification which shall be provided with the final approved Contractor's Construction Schedule:

CERTIFICATION

The Undersigned Contractor certifies that the network of activities displayed in the approved Contractor's Construction Schedule, CPM, is the true graphic representation of their plan of construction for the contract Work. The Contractor further certifies that they will prosecute the work in accordance with this schedule unless a change in his plan of operations is implemented, in accordance with the Contract Documents. The Contractor acknowledges that the Contractor's Construction Schedule shall be the instrument by which progress is measured and, together with the dollar value assigned to each activity, shall be the basis of monthly progress payments per the Contract Documents.

SIGNED_____ DATE
TITLE
COMPANY

2.4 FORMAT FOR CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM)

A. The Contractor's Construction Schedule shall be a time scaled cost loaded Critical Path Method (CPM) activity on arrow format.

B. No activity on the schedule shall have a duration longer than 15 days, with the exception of fabrication and procurement activities, unless otherwise acceptable to the State.

C. The Schedule shall include milestone activities showing the point of Substantial Completion and completion for each stage of the work.

D. Dependencies (or relationships) and logic between activities shall be shown so that the effect of progress (or lack of progress) on related activities and the overall schedule can be monitored.

E. A Procurement Log shall be submitted as part of the Contractor's Constructions Schedule. This Procurement Log shall, at a minimum, include the following information for each type of material or equipment provided under this contract:

1. Material or equipment description.
2. Technical specification reference.
3. Duration in days required for preparation of submittals.
4. Duration in days required for fabrication and delivery.
5. Cross reference to all activities of the Contractor's Construction Schedule, which will be constrained by the delivery date of this material or equipment item.
6. Total cost of invoices to be submitted for payment on delivery of each procurement item.
7. Scheduled delivery dates.

F. Activities on the Contractor's Construction Schedule that are dependent on submittal acceptance and/or material delivery shall not be scheduled to start earlier than the expected acceptance or delivery dates. Contractor shall normally allow a minimum of fourteen (14) days for submittal review by the Architect.

G. The total cost of performing each activity shall be shown on the schedule. This will be the total of all labor, material, equipment cost, overhead, and profit. The material cost assigned to the Procurement Log shall be the actual invoice value of such material, without any markup. The sum of the cost of the activities in the Procurement Log and the activities in the Contractor's Construction Schedule shall equal the total contract value.

H. Activity durations shall be the total of the actual working days required to perform that activity. Adverse weather conditions shall be based upon an allowance of 30 days per year. Weather is a time only change. (Refer to 4.3.6 and 4.3.7 of General Conditions.) The total allowable weather delay shall be shown as an independent activity on the critical path.

I. The resources required (manpower and major equipment) to perform each activity shall be identified.

J. Each activity shall be assigned a responsibility code corresponding to the subcontractor responsible for performing the work so that schedule activity lists and cost subtotals can be generated for each division of work.

K. No activities shall be scheduled during the last fourteen (14) calendar days of contract time of each stage (extending from the date of Substantial Completion to Final Completion);except activities related to the development of punch list(s) by the Architect, execution of punch list items and final cleaning by the Contractor.

L. The Contractor's Construction Schedule shall be submitted in quadruplicate in a plotted 24" x 36" format consisting of one contact-print reproducible and three copies thereof. (Network report format on 8 1/2" x 11" sheets).

M. Schedule Updating: Minimum twice per Application for payment; (one concurrent with Application for Payment), approximately every two weeks.

2.5 RECOVERY PLAN

A. If the Contractor is behind schedule by more than 15 calendar days for any stage of work, based on the latest updated version of the Contractor's Construction Schedule, after incorporating all approved time extensions, the Contractor will submit to the Architect within 10 days of notification by Architect of such delay a "recovery plan". This recovery plan shall be based on proposed revisions to the Contractor's Construction Schedule for the next 60-day period and shall show how the Contractor intends to bring the work back on schedule. The recovery plan shall also include a written description of the measures that the Contractor intends to incorporate.

2.6 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Meter readings and similar recordings.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Construction Change Directives received.
14. Services connected and disconnected.

15. Equipment or system tests and startups.
16. Partial Completions and occupancies.
17. Substantial Completions authorized.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.7 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01320

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting Applications for Payment.
2. Division 1 Section "Project Management and Coordination" for submitting Coordination Drawings.
3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
4. Division 1 Section "Quality Requirements" for submitting test and inspection reports and for erecting mockups.
5. Division 1 Section "Closeout Procedures" for submitting warranties Project Record Documents and operation and maintenance manuals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect's responsive action.

B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

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

C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. Incomplete Submittals: Furnish all submittal information required by individual Sections in single submittal unless otherwise allowed by Architect. Do not submit incomplete submittals. Incomplete submittals will be returned without action.

E. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.

1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.
3. Allow 15 days for processing each resubmittal.
4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

F. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 4 by 5 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. DFCM project no.
    c. Date.
    d. Name and address of Architect.
    e. Name and address of Contractor.
    f. Name and address of subcontractor.
    g. Name and address of supplier.
    h. Name of manufacturer.
    i. Unique identifier, including revision number.
    j. Number and title of appropriate Specification Section.

k. Drawing number and detail references, as appropriate.
l. Other necessary identification.

G. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

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

I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.

1. 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. Submittal and transmittal distribution record.
i. Remarks.
j. Signature of transmitter.

J. 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.

K. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Number of Copies: Submit four copies of each submittal, unless otherwise indicated. Architect will return minimum 2 copies. Mark up and retain one returned copy as a Project Record Document.

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 printed 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 written recommendations.
    b. Manufacturer's product specifications.
    c. Manufacturer's installation instructions.
    d. Standard color charts.
    e. Manufacturer's catalog cuts.
    f. Wiring diagrams showing factory-installed wiring.
    g. Printed performance curves.
    h. Operational range diagrams.
    i. Mill reports.
    j. Standard product operating and maintenance manuals.
    k. Compliance with recognized trade association standards.
    l. Compliance with recognized testing agency standards.
    m. Application of testing agency labels and seals.
    n. Notation of coordination requirements.

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.

1. Preparation: Include the following information, as applicable:

    a. Dimensions.
    b. Identification of products.
    c. Fabrication and installation drawings.
    d. Roughing-in and setting diagrams.
    e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
    f. Shopwork manufacturing instructions.
    g. Templates and patterns.
    h. Schedules.
    i. Design calculations.
    j. Compliance with specified standards.
    k. Notation of coordination requirements.
    l. Notation of dimensions established by field measurement.

2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
4. Number of Copies: Submit four blue- or black-line prints. Architect will return minimum 2 prints.

D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."

E. Samples: Prepare physical units of materials or products, including the following:

1. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.
2. 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.
3. Samples for Verification: Where specified, submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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.
4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:

    a. Generic description of Sample.
    b. Product name or name of manufacturer.
    c. Sample source.

5. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:

    a. Size limitations.
    b. Compliance with recognized standards.
    c. Availability.
    d. Delivery time.

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

    a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.
    b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

7. Number of Samples for Initial Selection: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected

from manufacturer's product line. Architect will return submittal with options selected.

8. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.

    a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

9. 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.

F. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."

G. Application for Payment: Comply with requirements in Division 1 Section "Payment Procedures."

H. Schedule of Values: Comply with requirements in Division 1 Section "Payment Procedures."

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of Contractor, testing agency, or design professional responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of the company.
3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."

B. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and

addresses, names and addresses of architects and owners, and other information specified.

D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

J. Preconstruction Test Reports: Prepare 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.

K. Compatibility Test Reports: Prepare 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.

L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.

M. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. 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.

N. Research/Evaluation Reports: Prepare 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.

O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures."

P. Design Data: Prepare 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.

Q. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

R. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

S. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. 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. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

C. Action Stamp: The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:

1. Final Unrestricted Release: When the Architect marks a submittal "No Exception Taken," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
2. Final-But-Restricted Release: When the Architect marks a submittal "Note Marked Exceptions," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
3. Returned for Resubmittal: When the Architect marks a submittal “Revise and Resubmit," or “Rejected” do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.

   a. Do not use, or allow others to use, submittals marked "Revise and Resubmit" or “Rejected” at the Project Site or elsewhere where Work is in progress.

4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Architect will return the submittal marked "Action Not Required."

D. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.

E. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

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

END OF SECTION 01330

SECTION 01400 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Division 1 Section "Cutting and Patching" for repair and restoration of construction disturbed by testing and inspecting activities.
2. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project,

whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. 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 the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

1.6 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Where indicated as the Contractor' responsibility, provide quality-control services specified.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Special Tests and Inspections: Owner will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

1. Testing agency will notify Owner, Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
2. Testing agency will submit a certified written report of each test, inspection, and similar quality control service to Owner, Architect and with copy to Contractor and to authorities having jurisdiction.
3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
5. Testing agency will retest and reinspect corrected work.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Owner, Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01400

SECTION 01420 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": The term "approved," when used in conjunction with Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.

D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings; or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at Project site including unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is Contractor or another entity engaged by Contractor, as an employee, subcontractor, or contractor of lower tier, to perform a particular construction operation, including installation, erection, application, and similar operations.

J. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. "Project site" is the space available for performing construction activities, either exclusively or in conjunction with others performing other work as part of Project. The extent of Project site is shown on the Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of the date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: Where compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from the publication source and make them available on request.

E. Abbreviations and Names: Abbreviations and acronyms are frequently used in the Specifications and other Contract Documents to represent the name of a trade association, standards-developing organization, authorities having jurisdiction, or other entity in the context of referencing a standard or publication. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of these entities. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01420

SECTION 01500 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Temporary utilities include, but are not limited to, the following:

1. Sewers.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Heating and cooling facilities.
5. Ventilation.
6. Electric power service.
7. Lighting.
8. Telephone service.

C. Support facilities include, but are not limited to, the following:

1. Dewatering facilities and drains.
2. Project identification and temporary signs.
3. Waste disposal facilities.
4. Field offices.
5. Storage and fabrication sheds.
6. Lifts and hoists.
7. Temporary elevator usage.

D. Security and protection facilities include, but are not limited to, the following:

1. Environmental protection.
2. Stormwater control.
3. Enclosure fence.
4. Security enclosure and lockup.
5. Barricades, warning signs, and lights.
6. Temporary enclosures.
7. Temporary partitions.
8. Fire protection.

E. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
2. Division 1 Section "Execution Requirements" for progress cleaning requirements.
3. Divisions 2 through 16 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

1. Owner's construction forces.
2. Occupants of Project.
3. Architect.
4. Testing agencies.
5. Personnel of authorities having jurisdiction.

B. Water Service: Use water from Owner's existing water system without metering and without payment of use charges.

C. Electric Power Service: Pay electric power service use charges, for electricity used by all entities engaged in construction activities at Project site. If electric power is taken from the Owners existing system, it must be metered independently by a meter provided by the Contractor.

1.5 SUBMITTALS

A. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

1.6 QUALITY ASSURANCE

A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

1.7 PROJECT CONDITIONS

A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.

B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.

C. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."

D. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.

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

F. Paint: Comply with requirements in Division 9 Section "Painting."

G. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

H. Water: Potable.

2.2 EQUIPMENT

A. General: Provide equipment suitable for use intended.

B. Field Offices: Prefabricated, mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Drinking-water fountains or containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.

1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.

F. Heating Equipment: Unless Owner authorizes use of permanent heating 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, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.

G. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

H. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

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.

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

C. Provide a minimum 3 days notice to Owner (DFCM), and user/agency/institution for shut downs, unless a longer time is required by the user/agency/institution.

3.2 TEMPORARY UTILITY INSTALLATION

A. Water Service: Use of Owner's existing water service 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.

1. Provide rubber hoses as necessary to serve Project site.

B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities. Keep sanitary facilities clean at all times.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
4. Drinking-Water Facilities: Provide bottled-water, drinking-water units.

   a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.

5. Locate toilets and drinking-water fixtures so personnel need not walk more than 200 feet to facilities.

C. 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 from that specified that will not have a harmful effect on completed installations or elements being installed.

1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.

D. 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 from that specified 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.

E. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

F. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
2. Provide warning signs at power outlets other than 110 to 120 V.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.

H. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.

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 an answering machine, voice-mail service, or messaging service on superintendent's telephone.
3. Provide a portable cellular telephone for superintendent's use in making and receiving telephone calls when away from field office.
4. Long distance call charges made by the Contractor to the Owner or Architect shall be borne by the Contractor.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.

3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

C. Dewatering Facilities and Drains: Comply with requirements in applicable Division 2 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. 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 property nor endanger permanent Work or temporary facilities.
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
3. Remove snow and ice as required to minimize accumulations.

D. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated. Sign is to contain the following :

   a. Name of project.
   b. DFCM as Owner for the State of Utah.
   c. Architect.
   d. Architect’s consultants.
   e. Contractor.
   f. Mechanical subcontractor.
   g. Electrical subcontractor.

2. Sign size shall be a minimum of 4 feet by 8 feet.
3. Prepare temporary signs to provide directional information to construction personnel and visitors.
4. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
5. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.

E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.

F. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 10 persons at Project site. Keep office clean and orderly.

1. Furnish and equip offices as follows:

   a. Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
   b. Water cooler.
   c. Provide a room of not less than 160 sq. ft. for Project meetings. Furnish room with conference table, 10 folding chairs, and 4-foot- square tack board.

2. Provide an electric heater with thermostat capable of maintaining a uniform indoor temperature of 68 deg F. Provide an air-conditioning unit capable of maintaining an indoor temperature of 72 deg F.
3. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.

G. Storage and Fabrication Sheds: Provide weathertight sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.

1. Construct framing, sheathing, and siding using fire-retardant-treated lumber and plywood.
2. Paint exposed lumber and plywood with exterior-grade acrylic-latex emulsion over exterior primer.

H. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Elevator Usage: Refer to Division 14 Sections for temporary use of new elevators.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful

noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.

B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.

C. Enclosure Fence: Before construction operations begin, install chain-link enclosure fence with lockable entrance gates. Locate where indicated. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.

1. Set fence posts in compacted mixture of gravel and earth.
2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
3. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

D. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

1. For safety barriers and similar uses, provide minimum 5/8-inch- thick exterior plywood.

E. 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, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.

F. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

1. Construct dustproof partitions of not less than nominal 4-inch studs, 5/8-inch gypsum wallboard with joints taped on occupied side, and 1/2-inch fire-retardant plywood on construction side.
2. Insulate partitions to provide noise protection to occupied areas.

3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
4. Protect air-handling equipment.
5. Weatherstrip openings

G. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.

   a. Provide class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
   b. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.
3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
6. Develop and supervise an overall fire-prevention and first-aid fire-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.
7. Provide hoses for fire protection of sufficient length to reach construction areas. 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 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. Protect from damage caused by freezing temperatures and similar elements.

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.

2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. 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 the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

END OF SECTION 01500

SECTION 01600 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions.

B. Related Sections include the following:

1. Division 1 Section "References" for applicable industry standards for products specified.
2. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

D. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A or equivalent.
2. 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, size, durability, visual effect, and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. 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.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

l. 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.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

   a. Form of Acceptance: Change Order.
   b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

   1. Schedule delivery to minimize long-term storage at Project 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 Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
   5. Store products to allow for inspection and measurement of quantity or counting of units.
   6. Store materials in a manner that will not endanger Project structure.
   7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   9. Protect stored products from damage.

B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

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

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
2. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
3. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions “Comparable Products” article to obtain approval for use of an unnamed product.
4. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in “Comparable Products” article to obtain approval for use of an unnamed product.
5. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.
6. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of

pensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.
10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

<u>SECTIONS WITH WARRANTIES/GUARANTEES INCLUDE THE FOLLOWING:</u>

Refer to individual Sections for detailed requirements.

03300 CAST-IN-PLACE CONCRETE
07411 METAL ROOF PANELS
07531 EPDM SINGLE-PLY MEMBRANE ROOFING

07920 JOINT SEALANTS
08211 FLUSH WOOD DOORS
08410 ALUMINUM ENTRANCES AND STOREFRONTS
08711 DOOR HARDWARE
08716 POWER DOOR OPERATORS
08800 GLAZING
08920 GLAZED ALUMINUM CURTAIN WALLS
09680 CARPET
10100 VISUAL DISPLAY BOARDS
10431 FREESTANDING SIGNS
10801 TOILET AND BATH ACCESSORIES
15000 MECHANICAL WARRANTIES
16269 VARIABLE FREQUENCY CONTROLLERS
16511 INTERIOR LIGHTING

END OF SECTION 01600

SECTION 01700 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. General installation of products.
3. Coordination of Owner-installed products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, water-service piping; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner, and the user/agency/institution not less than three days in advance of proposed utility interruptions.

C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

A. General: Lay out Work using accepted surveying practices.

1. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
2. Inform installers of lines and levels to which they must comply.
3. Check the location, level and plumb, of every major element as the Work progresses.
4. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

B. Site Improvements: Locate and lay out site improvements, including pavements, utility slopes, and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

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

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

SECTION 01731 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Sections include the following:

1. Division 7 Section "Through-Penetration Firestop Systems" for patching fire-rated construction.
2. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

   a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.3 DEFINITIONS

A. Cutting: Removal of existing 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 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 the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.
2. Air or smoke barriers.

3. Fire-protection systems.
4. Control systems.
5. Electrical wiring systems.

C. Miscellaneous Elements: Do not cut and patch the following 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.

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.

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

a. Roofing.
b. Firestopping.
c. Window wall system.
d. HVAC enclosures, cabinets, or covers.

1.5 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 of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing 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 existing 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 existing 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 existing 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.

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 existing 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 existing 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. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete/Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
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 of these Specifications.

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

END OF SECTION 01731

SECTION 01732 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Repair procedures for selective demolition operations.

B. Related Sections include the following:

1. Division 1 Section "Work Restrictions" for restrictions on use of the premises due to Owner occupancy.
2. Division 1 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
3. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
4. Division 2 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.
5. Division 15 Sections for demolishing, cutting, patching, or relocating mechanical items.
6. Division 16 Sections for demolishing, cutting, patching, or relocating electrical items.

1.3 DEFINITIONS

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

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

C. 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.

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

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 on-site operations are uninterrupted.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of 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.

C. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.6 QUALITY ASSURANCE

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

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

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of buildings immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than three days notice to Owner of activities that will affect Owner's operations.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for condition of areas to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

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

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

E. Storage or sale of removed items or materials on-site will not be permitted.

F. 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.

1.8 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

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

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.

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

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

1. Provide at least three days notice to Owner if shutdown of service is required during changeover.

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. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
3. Protect existing site improvements, appurtenances, and landscaping to remain.
4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

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.

C. Temporary Enclosures: Provide temporary enclosures for protection of existing building and 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, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

D. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

E. Temporary Shoring: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction 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 POLLUTION CONTROLS

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

C. Cleaning: 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.

3.5 SELECTIVE DEMOLITION

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.
10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. Existing Facilities: Comply with Owner's requirements for using and protecting elevators, stairs, walkways, building entries, and other building facilities during selective demolition operations.

C. Removed and Reinstalled Items: Comply with the following:

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.

3.6 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with Division 1 Section "Cutting and Patching."

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

E. Floors and Walls: Where walls or partitions that are demolished 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 existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

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

END OF SECTION 01732

SECTION 01770 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Inspection procedures.
2. Project Record Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
3. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for products of those Sections.

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 in request. See General Conditions Paragraph “SUBSTANTIAL COMPLETION”.

1. Advise Owner of pending insurance changeover requirements.
2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. 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.
4. Prepare and submit Project Record Documents, operation and maintenance manuals, damage or settlement surveys, and similar final record information.

5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable. Obtain a signed receipt from Owner for above materials.
6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
7. Complete startup testing of systems.
8. Submit test/adjust/balance records.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Advise Owner of changeover in heat and other utilities.
11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
12. Complete final cleaning requirements, including touchup painting.
13. 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 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

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following (See General Conditions Paragraph “FINAL COMPLETION AND FINAL PAYMENT”):

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or

will notify Contractor of construction 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.

1.5 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

   a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later. Locate concealed elements from a permanent structure or reference point.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
   d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. Mark important additional information that was either shown schematically or omitted from original Drawings.
4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.6 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:

   a. Emergency instructions and procedures.
   b. System, subsystem, and equipment descriptions, including operating standards.
   c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
   d. Description of controls and sequence of operations.
   e. Piping diagrams.

2. Maintenance Data:

   a. Manufacturer's information, including list of spare parts.
   b. Name, address, and telephone number of Installer or supplier.
   c. Maintenance procedures.
   d. Maintenance and service schedules for preventive and routine maintenance.
   e. Maintenance record forms.
   f. Sources of spare parts and maintenance materials.
   g. Copies of maintenance service agreements.

h. Copies of warranties and bonds.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

C. Provide a minimum of 3 copies of complete operation and maintenance manuals, unless a greater number is specified elsewhere.

1.7 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 Insert number days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide minimum of two complete copies of warranty binders.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

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.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors experienced in operation and maintenance procedures.
2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.2 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution 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 similar labels, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
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.
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. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 02230 - SITE CLEARING

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. Clearing and grubbing.
2. Removal of above- and below-grade improvements.

B. Related Sections include the following:

1. Division 1 Section "Execution Requirements" for verifying utility locations and for recording field measurements.
2. Division 1 Section "Temporary Facilities and Controls" for temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures during site operations.
3. Division 2 Section "Earthwork" for soil materials, excavating, and backfilling

1.3 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.4 SUBMITTALS

A. Photographs, sufficiently detailed, of existing adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

B. Record drawings according to Division 1 Section "Closeout Procedures."

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Notify Blue Stakes utility locator service for location of existing underground utilities minimum of 48 hours prior to site clearing.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.
3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.

3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
4. Backfill with soil as soon as possible.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.3 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than three days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, grass, and other vegetation to permit installation of new construction.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding 6-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove walks as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.6 DISPOSAL

A. Disposal: Remove surplus soil material, topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 02230

SECTION 02300 - EARTHWORK

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. Preparing subgrades for slabs-on-grade and walks.
2. Excavating and backfilling for buildings and structures.
3. Structural fill.
4. Drainage course for slabs-on-grade.
5. Subbase course for concrete walks.
6. Excavating and backfilling trenches within building lines.
7. Excavating and backfilling trenches for buried mechanical and electrical utilities.

B. Related Sections include the following:

1. Division 2 Section "Site Clearing" for site stripping and grubbing.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations.

1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades or excavations.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. Subbase Course: Layer placed between the subgrade and a concrete walk.

I. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase or drainage fill.

J. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each borrow soil material proposed for fill and backfill.

1.5 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Owner and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than three days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner written permission.

3. Contact Blue Stakes utility locator service for location of existing buried utilities, minimum 48 hours prior to excavating.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, roots, topsoil, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Structural fill or satisfactory soil materials as indicated.

E. Subbase: Well graded 4-inch-minus granular material, and free of topsoil, roots, debris, and other deleterious material. Limit material passing a No. 200 sieve to not more than 13 percent of that portion which passes a 2-inch sieve. Material passing a No. 200 sieve to have plastic index (PI) value of 6 or lower.

F. Structural Fill: Well graded 4-inch-minus granular material having less than 15 percent passing the No. 200 sieve, and free of topsoil, roots, debris, and other deleterious material.

G. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Fill: Well sorted pea gravel, or 3/4 inch to 1-inch-minus gap-graded gravel with less than 10 percent passing a No. 4 sieve and less than 2 percent passing a No. 200 sieve, unless otherwise approved.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core

encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, walks, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: At the bottom of the stripped vegetation or excavations, but prior to placement of any fill or concrete, the upper 12 inches of exposed subgrade should be moisture conditioned and properly compacted to at least 95 percent relative compaction (ASTM D-698, standard Proctor). If soft or loose soils are encountered, they should be moisture conditioned and recompacted or removed and replaced with structural fill. An alternative subgrade preparation of clayey soils may be accomplished by excavating to grade, leaving a smooth unworked surface, and allowed to thoroughly dry. The depth of drying shall be a minimum of 6 inches and shall be monitored and approved by the engineer prior to proceeding with fill. However, loosened material shall be moisture conditioned and compacted to at least 95 percent of the maximum dry density. It should be anticipated that localized areas of soft natural soils may exist which would require over-excavation and replacement with compacted structural fill.

3.6 EXCAVATION FOR WALKS

A. Excavate surfaces under walks to indicated cross sections, elevations, and grades.

B. Before placement of any fill walk on existing grade, the upper 12 inches of all exposed subgrades should be prepared by moisture conditioning and compaction to 95 percent of the laboratory dry density as determined by the ASTM D-698 (standard Proctor) method of compaction. All loosened material shall be moisture conditioned and compacted to at least 95 percent of the maximum dry density. For clayey soils, an alternative subgrade preparation may be accomplished by excavating to grade, leaving a smooth unworked surface and allowed to throughly dry. The depth of drying shall be a minimum of 6 inches and shall be monitored and approved by the engineer prior to proceeding with fill. However, loosened material shall be moisture conditioned and compacted to at least 95 percent of the maximum dry density. It should be anticipated that localized areas of soft natural soils may exist which would require over-excavation and replacement with compacted structural fill.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, details, and elevations.

3.8 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. If soft or loose soils are present at or immediately below proposed floor, foundations levels, or structural fill, moisture condition and compact, or remove and replace with structural fill. If frozen soils are present at or immediately below the floor, foundation levels, or structural fill, remove to suitable bearing soils.

C. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Do not place structural fill on unsuitable soils. Unsuitable soils include loose, soft or disturbed soils, construction debris, frozen soils, or topsoil.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

3.9 PREPARATION OF EXISTING SUBGRADE

A. Moisture condition and compact exposed subgrade. If soft or loose soils are encountered, moisture condition and compact, or remove and replaced with structural fill.

B. Compact existing subgrade to not less than the following percentages of maximum dry density according to ASTM D 698:

1. Under structures, building slabs and walks, scarify and recompact top 12 inches of existing subgrade at 95 percent.
2. Under lawn or unpaved areas, scarify and recompact top 6 inches of existing subgrade at 85 percent.

C. If existing subgrade becomes disturbed after compaction, recompact in accordance with above requirements

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations.

3.12 BACKFILL

A. Place backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.

B. Place and compact backfill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material or structural fill.
2. Under walks, use structural fill.

3.13 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 12 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.

D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of structural fill material to final subgrade.

G. Install warning tape directly above utilities, 12 to 16 inches below finished grade, except 6 inches below subgrade under slabs and walks.

3.14 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Extend structural fill horizontally one foot for each foot of fill placed below footings or other structural features.

D. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material or structural fill.
2. Under walks, use structural fill.
3. Under building slabs, use structural fill.
4. Under footings and foundations, use structural fill.

3.15 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:

1. Under structures, building slabs, and walks, compact each layer of backfill or fill material at 95 percent.
2. Under lawn or unpaved areas compact each layer of backfill or fill material at 85 percent.

D. If structural fill becomes disturbed after compaction, recompact in accordance with above requirements.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBBASE COURSE

A. Under walks, place subbase course on prepared subgrade and as follows:

1. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry density according to ASTM D 1557.
2. Shape subbase to required crown elevations and cross-slope grades.
3. When thickness of compacted subbase course is 6 inches or less, place materials in a single layer.
4. When thickness of compacted subbase course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.19 DRAINAGE COURSE

A. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:

1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.
3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Footing Subgrade: At footing subgrades, perform at least one test of each soil stratum or lift for compacted fill, for every 15 lineal feet of continuous footing, and at each spot footing, to verify design bearing capacities.
2. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
3. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 40 feet or less of wall length, but no fewer than two tests.
4. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 40 feet or less of trench length, but no fewer than two tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 02300

SECTION 02751 - CEMENT CONCRETE PAVEMENT

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 exterior cement concrete pavement for the following:

1. Curbs and gutters.
2. Walks.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for subgrade preparation, grading, and subbase course.
2. Division 2 Section "Pavement Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.
3. Division 3 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

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

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed pavement 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. Manufacturer Qualifications: Manufacturer of 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 Mix Concrete Association's Plant Certification Program.

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

D. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. 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.

2.2 STEEL REINFORCEMENT

A. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete.

2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type II.

1. Fly Ash: ASTM C 618, Class F.

C. Aggregate: ASTM C 33, uniformly graded, from a single source, with coarse aggregate as follows:

1. Maximum Aggregate Size: 1 inch nominal.
2. Do not use fine or coarse aggregates containing substances that cause spalling.

D. Water: ASTM C 94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Water-Reducing Admixture: ASTM C 494, Type A.

2.5 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

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

2.6 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

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

1. Do not use Owner's field quality-control testing agency as the independent testing agency.

C. Proportion mixes to provide concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi (Slabs, Walks).

2. Compressive Strength (28 Days): 3000 psi (Straight Back Curbs, Curb and Gutter).
3. Slump Limit: 3 inches.

   a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches after adding admixture to plant- or site-verified, 2- to 3-inch slump.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94..

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

B. Remove loose material from compacted subbase surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.

   a. Radius: 1/4 inch.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 1/4 inch.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

H. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades,

finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

I. 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, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

J. 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 at time of placement below 90 deg F. 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 reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

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.

3.7 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 follow recommendations in ACI 305R for hot-weather protection during curing.

B. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

C. Curing Methods: Cure concrete by moisture curing:

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

a. Water.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Joint Spacing: 3 inches.
6. Contraction Joint Depth: Plus 1/4 inch, no minus.
7. Joint Width: Plus 1/8 inch, no minus.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection 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.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C 172, except modified for slump to comply with ASTM C 94.
2. Slump: ASTM C 143; one test at point of placement for each compressive-strength test, but not less than one test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.

5. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.
7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
8. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
10. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, 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.

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

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 02751

SECTION 02764 - PAVEMENT JOINT SEALANTS

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. Expansion and contraction joints within portland cement concrete pavement.

B. Related Sections include the following:

1. Division 2 Section "Cement Concrete Paving" for constructing joints in concrete paving.
2. Division 7 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Qualification Data: For firms and persons specified in "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.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

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 date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than that 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.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.2 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.

B. Available Products: Subject to compliance with requirements, cold-applied joint sealants that may be incorporated into the Work include, but are not limited to, the following:

1. Multicomponent Low-Modulus Sealant for Concrete and Asphalt:

   a. SOF-SEAL; W.R. Meadows, Inc.

2.3 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint- sealant-substrate tests and field tests.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions applicable to products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint 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 and from damage resulting from construction operations or other causes so sealants 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 installations with repaired areas are indistinguishable from the original work.

END OF SECTION 02764

SECTION 03300 - CAST-IN-PLACE CONCRETE

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 specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.

B. Related Sections include the following:

1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.
2. Division 2 Section "Cement Concrete Pavement" for concrete pavement and walks.

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. Product Data: For each type of manufactured material and product indicated.

B. 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.

C. 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.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork. Design and engineering of formwork are Contractor's responsibility.

1. Shoring and Re-shoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing re-shoring.

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

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. 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.

C. 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.

D. Welding: Welding of reinforcing bars is not permitted.

E. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 301, "Specification for Structural Concrete."
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 SPECIAL PROJECT WARRANTY

A. Provide written warranty in form approved by the Owner to promptly remove and/or repair defective concrete (pitting, spalling, cracking, honeycombing, etc.) as directed by the Owner, and at the Contractor’s expense. Provide similar warranty for replacement concrete.

B. Warranty Period: 2 years after date of Substantial Completion or replacement.

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.

1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. 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.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: As indicated.

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

C. Plain-Steel Welded Wire Fabric: As indicated. Fabricate from as-drawn steel wire into flat sheets.

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. 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. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Portland Cement: as indicated

1. Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregate: as indicated, uniformly graded, and as follows:

1. Class: Moderate weathering region, but not less than 3M.
2. Nominal Maximum Aggregate Size: 3/4 inch.
3. 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 sieve, and less than 8 percent may be retained on sieves finer than No. 50.

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: as indicated.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.6 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. dry.

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

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

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

1. Evaporation Retarder:

   a. Spray-Film; ChemMasters.
   b. Eucobar; Euclid Chemical Co.
   c. SikaFilm; Sika Corporation.

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

   a. Safe-Cure & Seal 20; ChemMasters.
   b. Cure & Seal 18 percent E; Symons Corporation.
   c. Kure-N-Seal W; Sonneborn, Div. of ChemRex, Inc.

2.7 RELATED MATERIALS

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

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

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

2.8 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch 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 or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi at 28 days when tested according to ASTM C 109/C 109M.

2.9 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.

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

C. Footings, Foundation Walls, and Piers: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): As indicated.
2. Maximum Slump: As indicated.
3. Maximum Slump for Concrete Containing High-Range Water-Reducing Admixture: 8 inches after admixture is added to concrete with 2- to 4-inch slump.

D. Slab-on-Grade: Proportion normal-weight concrete mix as follows:

1. Compressive Strength (28 Days): As indicated.
2. Maximum Slump: As indicated.

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

1. Fly Ash: 15 percent.

F. Maximum Water-Cementitious Materials Ratio: 0.45 for concrete exposed to deicers or subject to freezing and thawing while moist.

G. 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- nominal maximum aggregate size.

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

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

J. 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.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

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

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

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.

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

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

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

K. 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.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of walls and similar parts of the Work, that do not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F 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. 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.

C. 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 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.

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. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as foundation walls and other locations, as indicated.

1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.

1. Use dowel sleeves or lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 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 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 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, uniformly heat water and aggregates before mixing to obtain a concrete mixture

temperature of not less than 50 deg F and not more than 80 deg F 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 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.

3.7 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 in height.

1. Apply to concrete surfaces exposed to public view.

C. 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.

3.8 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. 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 mortar setting beds for ceramic tile.

C. 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.

D. 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, or carpet.
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.

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

3.9 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.

3.10 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 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 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, and other surfaces, by the following method:

1. 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. Confirm that product used will not interfere with bonding of finish flooring materials applied directly to concrete.

3.11 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 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 in any dimension in solid concrete but not less than 1 inch 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 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 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 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 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 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 patching mortar.

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

3.12 FIELD QUALITY CONTROL

A. 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.

B. 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 at least one composite sample for each 20 cu. yd. 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.

2. 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.
3. 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.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. 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.
6. 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.

7. 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.

C. 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.

D. 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.

E. 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.

F. 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.

G. 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 03300

SECTION 04810 - UNIT MASONRY ASSEMBLIES

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 unit masonry assemblies consisting of the following:

1. Concrete masonry units.
2. Face brick.
3. Mortar and grout.
4. Reinforcing steel.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Related Sections include the following:

1. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.

C. Products installed, but not furnished, under this Section include the following:

1. Steel shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
2. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section "Steel Doors and Frames."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Shop Drawings: Show fabrication and installation details for the following:

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

C. Samples for Verification: For the following:

1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
2. Colored mortar Samples for each color required, showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
3. Weep holes/vents in color to match mortar color.
4. Accessories embedded in the masonry.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:

1. Each type of masonry unit required.

   a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.

2. Mortar complying with property requirements of IBC 2103.7 and ASTM C 270.
3. Grout mixes complying with compressive strength requirements of IBC 2103.10 and ASTM C 476. Include description of type and proportions of grout ingredients.

F. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

E. Sample Panels: Before installing unit masonry, build sample panels, using materials indicated for the completed Work, to verify selections made under sample Submittals and to demonstrate aesthetic effects. Build sample panels for each type of exposed unit masonry assembly in sizes approximately 48 inches long by 48 inches high by full thickness.

1. Locate panels in the locations indicated or, if not indicated, as directed by Architect.
2. Clean exposed faces of panels with masonry cleaner indicated.
3. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Maintain sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

   a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels, unless such deviations are specifically approved by Architect in writing.

7. Demolish and remove sample panels when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

1. Protect Type I concrete masonry units from moisture absorption so that, at the time of installation, the moisture content is not more than the maximum allowed at the time of delivery.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.

1. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. General: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, bonding, and other special conditions.

B. Concrete Masonry Units: ASTM C 90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated.
2. Weight Classification: As indicated.
3. Provide Type I, moisture-controlled units.
4. Size: As indicated.
5. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

2.2 BRICK

A. General: Provide shapes indicated and as follows for each form of brick required:

1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.

B. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels. Use special starter unit at corners consisting of standard unit with kerf, designed to allow removal of end quarter.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Face Brick: ASTM C 216, Grade SW, Type FBX , and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 8,000 psi.
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
5. Size: Manufactured to the following actual dimensions:

   a. Jumbo: 3-1/2 to 3-5/8 inches wide by 3-1/2 to 3-5/8 inches high by 15-1/2 to 15-5/8 inches long.

6. Color and Texture: Match existing building.
7. Available Manufacturers: Subject to compliance with requirements, manufacturer’s products that may be incorporated into the Work include, but are not limited to, the following:

a. Interstate Brick.
b. IXL.
c. Summit.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, as indicated.

C. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

D. Aggregate for Grout: ASTM C 404.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

F. Water: Potable.

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

1. Mortar Pigments:

a. True Tone Mortar Colors; Davis Colors.
b. Centurion Pigments; Lafarge Corporation.
c. SGS Mortar Colors; Solomon Grind-Chem Services, Inc.

2.4 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: As Indicated.

2.5 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Hot-Dip Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating.

C. Steel Sheet, Galvanized after Fabrication: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153.

2.6 ADJUSTABLE MASONRY-VENEER ANCHORS

1. General: As indicated
2. Seismic Masonry-Veneer Anchors: As indicated

    a. Available Products: As indicated

2.7 EMBEDDED FLASHING MATERIALS

A. Concealed Flashing: For flashing not exposed to the exterior, use the following, unless otherwise indicated:

1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. sheet copper bonded with asphalt between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.

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

1. Copper-Laminated Flashing:

    a. Copper Fabric Flashing; Advanced Building Products, Inc.
    b. H & B C-Fab Flashing; Hohmann & Barnard, Inc.
    c. Type FCC-Fabric Covered Copper; Phoenix Building Products.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Aluminum Weep Hole/Vent: One-piece, L-shaped units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel with louvers stamped in web and with a top flap to keep mortar out of the head joint; painted to comply with Division 9 Section "Painting," before installation, in color approved by Architect to match that of mortar.

B. Cavity Drainage Material: Free-draining mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings.

C. Available Products: Subject to compliance with requirements, cavity drainage materials that may be incorporated into the Work include, but are not limited to, the following:

1. Aluminum Weep Hole/Vent:

    a. Wilko Weephole Ventilators; Hohmann & Barnard, Inc.

2. Cavity Drainage Material:

    a. Mortar Break; Advanced Building Products, Inc.

b. CavClear Masonry Mat; CavClear.
c. Mortar Net; Mortar Net USA, Ltd.

2.9 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with IBC 2103.7 and ASTM C 270, Property Specification.

1. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
2. Mortar Type (concrete masonry units): As indicated.
3. Mortar Type (clay masonry units): Type S.

C. Pigmented Mortar (clay masonry units): Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:

1. For mineral-oxide pigments and portland cement-lime mortar, not more than 10 percent.
2. Mix to match existing building.

D. Grout for Unit Masonry: Comply with IBC 2103.10 and ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing and bonding of existing masonry.

E. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

B. For conspicuous vertical lines, such as external corners and door jambs, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

C. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.

D. For conspicuous horizontal lines, such as exposed lintels and parapets, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

E. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/16 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/16 inch.

F. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/16 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/16 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Match existing building.

C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.
2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. Lay solid brick-size masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

1. At cavity walls, bevel beds away from cavity, to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against the cavity face of the brick.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

3.6 CAVITIES

A. Keep cavities clean of mortar droppings and other materials during construction. Strike joints facing cavities flush.

1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

3.7 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten each anchor section through sheathing to wall framing and masonry backup with two metal fasteners of type indicated.
2. Embed connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 o.c. horizontally with not less than 1 anchor for each 1.78 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.8 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, and other obstructions to downward flow of water in wall.

B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install flashing as follows:

1. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches, and behind air-infiltration barrier.
2. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads and sills, extend flashing 4 inches at ends and turn flashing up not less than 2 inches to form a pan.
3. Cut flashing off flush with face of wall after masonry wall construction is completed.

D. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Use aluminum weep hole/vents to form weep holes.
2. Space weep holes 32 inches o.c.
3. Place cavity drainage material immediately above flashing in cavities

E. Install vents in vertical head joints at the top of each continuous cavity at 32 inches o.c. Use aluminum weep hole/vents to form vents.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.

1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.11 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below.

1. Payment for these services will be made by Owner.

2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Testing Frequency: As indicated for concrete masonry units, and each 5000 sq. ft. of wall area or portion thereof for clay masonry units.

C. Mortar properties will be tested as indicated and per ASTM C 780.

D. Grout will be sampled and tested for compressive strength as indicated and per ASTM C 1019.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.
4. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Recycling: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 04810

SECTION 05120 - 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. This Section includes structural steel.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 5 Section "Steel Deck" for field installation of shear connectors.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
3. 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.

D. 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.

E. 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.
4. Shop primers.
5. Nonshrink grout.

1.4 QUALITY ASSURANCE

A. Installer 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.

1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:

a. Category: Category II, complex steel building structures.
b. Fabricator shall be registered with and approved by authorities having jurisdiction.

C. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
2. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
3. AISC's "Seismic Provisions for Structural Steel Buildings."
4. ASTM A 6 "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
5. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

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 re-lubricate 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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel Shapes, Plates, and Bars: As follows:

1. Carbon Steel: As indicated.
2. High-Strength, Low-Alloy Columbium-Vanadium Steel: As indicated.

B. Cold-Formed Structural Steel Tubing: As indicated.

C. Shear Connectors: As indicated.

D. Anchor Rods, Bolts, Nuts, and Washers: As follows:

1. Unheaded Rods: ASTM A 307
2. High-Strength Unheaded Rods: ASTM A 449 as indicated.
3. Headed Bolts: As indicated.
4. Washers: As indicated.

E. High-Strength Bolts, Nuts, and Washers: As indicated.

1. Finish: Plain, uncoated.

F. Welding Electrodes: Comply with AWS requirements.

2.2 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

2.3 GROUT

A. 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.

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. Camber structural steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded.

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.

E. 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. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.

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 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:

1. SSPC-SP 3 "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, 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. 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.

2.7 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
2. Ultrasonic Inspection: ASTM E 164.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

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. 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.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. 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.

C. 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."

D. 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.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Finish sections thermally cut during erection equal to a sheared appearance.

H. 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. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. Bolts: ASTM A 325 high-strength bolts, unless otherwise indicated.
2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

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.

3.5 FIELD QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

   1. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
   2. Ultrasonic Inspection: ASTM E 164.

F. In addition to visual inspection, field-welded shear connectors will be inspected and tested according to requirements of AWS D1.1 for stud welding and as follows:

   1. Bend tests will be performed when visual inspections reveal either less than a continuous 360-degree flash or welding repairs to any shear connector.
   2. 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: 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.

END OF SECTION 05120

SECTION 05210 - STEEL JOISTS

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. Open-web K-series steel joists.
2. Joist accessories.

1.3 DEFINITIONS

A. Special Joists: Joists requiring modification by the manufacturer to support nonuniform, unequal, or special loading conditions that invalidate SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads within limits and under conditions indicated.

B. Design joists to withstand design loads with load deflections no greater than the following:

1. Roof Joists: Vertical deflection of 1/360 (live load) 1/240 (total load) of the span.

1.5 SUBMITTALS

A. Product Data: For each type of joist, accessory, and product indicated.

B. Shop Drawings: Show layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.

1. Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.

2. Comprehensive engineering analysis certified by the qualified professional engineer responsible for its preparation.

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

D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.

E. Qualification Data: For firms and persons specified in "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. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.

1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
3. Professional Engineer Qualifications: A professional engineer who is legally authorized 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 joists that are similar to those indicated for this Project in material, design, and extent.

B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with SJI's "Specifications" for chord and web members.

B. Steel Bearing Plates: ASTM A 36/A 36M.

C. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain, uncoated .

D. Welding Electrodes: Comply with AWS standards.

2.2 PRIMERS

A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.

2.3 OPEN-WEB K-SERIES STEEL JOISTS

A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.

1. Joist Type: K-series steel joists.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

E. Camber joists according to SJI's "Specifications."

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."

1. Furnish additional erection bridging if required.

C. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories to be primed by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.

C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Field welds will be visually inspected according to AWS D1.1.

C. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:

1. Ultrasonic Testing: ASTM E 164.
2. Liquid Penetrant Inspection: ASTM E 165.

D. Bolted connections will be visually inspected.

1. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

E. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.

F. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05210

SECTION 05310 - STEEL DECK

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. Roof deck.

B. Related Sections include the following:

   1. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

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

D. 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.

1.4 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. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

C. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

D. 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.

1.5 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.

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:

1. Steel Deck:

a. BHP Steel Building Products USA Inc.
b. Nucor Corp.; Vulcraft Div.
c. Verco Manufacturing Co.

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:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated
6. Side Laps: As indicated.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

C. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

D. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.

E. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

F. Shear Connectors: as indicated.

G. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. 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.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate decking bundles to prevent overloading of supporting members.

D. 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.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.3 ROOF DECK INSTALLATION

A. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
3. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated.

B. End Bearing: Install deck ends over supporting frame with a minimum end bearing as indicated, with end joints as follows:

1. End Joints: As indicated.

C. 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.

D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of as indicated.

1. End Joints: As indicated.

E. Shear Connectors: Weld shear connectors through deck to supporting frame according to AWS D1.1 and manufacturer's written instructions. Butt end joints of deck panels; do not overlap. Remove and discard arc shields after welding shear connectors.

F. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

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. Shear connector stud welds will be inspected and tested according to AWS D1.1 for stud welding and as follows:

1. Shear connector stud welds will be visually inspected.
2. Bend tests will be performed if visual inspections reveal less than a full 360-degree flash or welding repairs to any shear connector stud.
3. Tests will be conducted on additional shear connector studs if weld fracture occurs on shear connector studs already tested according to AWS D1.1.

D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Remove and replace work that does not comply with specified requirements.

F. 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 05310

SECTION 05400 - 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior non-load-bearing wall framing.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
2. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing metal-stud framing and ceiling-suspension assemblies.
3. Division 9 Section "Gypsum Sheathing" for gypsum sheathing and air infiltration barriers.

1.3 DEFINITIONS

A. Minimum Uncoated Steel Thickness: Minimum uncoated thickness of cold-formed framing delivered to the Project site shall be not less than 95 percent of the thickness used in the cold-formed framing design. Lesser thicknesses shall be permitted at bends due to cold forming.

B. Producer: Entity that produces steel sheet coil fabricated into cold-formed members.

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining Work.

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

D. 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. Expansion anchors.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Miscellaneous structural clips and accessories.

E. Research/Evaluation Reports: Evidence of cold-formed metal framing'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 cold-formed metal framing 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. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

C. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

D. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing:

1. CCFSS Technical Bulletin: "AISI Specification Provisions for Screw Connections."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. Clark Steel Framing Industries.
2. Dale Industries, Inc.
3. Unimast, Inc.
4. Allied Studco

2.2 MATERIALS

A. Steel Sheet: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: as indicated.
2. Coating: G60.

2.3 NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, complying with ASTM A 570, and as follows:

1. Minimum Uncoated-Steel Thickness: 0.0566 inch.
2. Flange Width: 1-5/8 inches.
3. Depth: As indicated.
4. Section Properties: Moment of Inertia: I = 0.843 in. Section Modulus: S = 0.429 in.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, complying with ASTM A 570, and as follows:

1. Minimum Uncoated-Steel Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.

B. Provide as applicable accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. End clips.
5. Foundation clips.
6. Gusset plates.
7. Stud kickers, knee braces, and girts.
8. Hole reinforcing plates.
9. Backer plates.

2.5 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.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: Corrosion-resistant-coated, self-drilling, self-threading steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations 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 metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 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 not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, 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 and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to ASTM C 1007, unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. 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.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to manufacturer's written recommendations and requirements in this Section.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 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 not less than three exposed screw threads.

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 and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

I. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 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.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

E. Install horizontal bridging in wall studs, spaced in rows indicated, but not more than 54 inches apart. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain-wall-framing system.

3.4 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal 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, that ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05400

SECTION 05500 - METAL FABRICATIONS

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. Steel ladders.
2. Shelf angles and lintels.
3. Attachments and brackets for elevator guide rails.
4. Support angles for elevator door sills.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural-steel framing system components.
2. Division 5 Section "Pipe and Tube Railings" for metal pipe railings.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Paint products.

B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1. Provide templates for anchors and bolts specified for installation under other Sections.

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

D. Qualification Data: For firms and persons specified in "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.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. 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: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

C. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

D. Malleable-Iron Castings: ASTM A 47, Grade 32510.

E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."

B. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

D. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

D. Machine Screws: ASME B18.6.3.

E. Plain Washers: Round, carbon steel, ASME B18.22.1.

F. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

H. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. 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. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. 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.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.6 STEEL LADDERS

A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

B. Siderails: As indicated.

C. Bar Rungs: As indicated.

D. Provide galvanized ladder.

E. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

F. Provide nonslip surfaces on top of each rung by using a type of manufactured rung filled with aluminum-oxide grout.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete masonry or steel studs.

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. Galvanize shelf angles located in exterior walls.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.

B. Fabricate units from structural-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 retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

C. Fabricate supports for operable partitions as follows:

1. Beams: Continuous steel shapes of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

2.9 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Galvanize pipe bollards.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Galvanize steel in exterior locations. Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. 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, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, and other connectors.

B. 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.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. 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.

E. 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.

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, if any.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed 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 05500

SECTION 05521 - PIPE AND TUBE RAILINGS

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. Steel pipe and cable railings, at interior locations.

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."

B. Structural Performance of Railings: Provide railings capable of withstanding the following structural loads without exceeding allowable design working stresses of materials for railings, anchors, and connections:

1. Top Rail of Guards: Capable of withstanding the following loads applied as indicated:

a. Concentrated load of 200 lbf applied at any point and in any direction.
b. Uniform load of 50 lbf/ft. applied in any direction.
c. Concentrated and uniform loads above need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

3. Terminal Posts for Cables: Capable of withstanding loads as recommended by cable manufacturer, but not less than 350 lbs. tension per cable.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Grout, anchoring cement, and paint products.

B. Shop Drawings: Show fabrication and installation of railings, and cables. Include plans, elevations, sections, component details, and attachments to other Work.

1. For installed railings indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For firms and persons specified in "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.

1.5 QUALITY ASSURANCE

A. 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 railings that are similar to those indicated for this Project in material, design, and extent.

B. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

1.6 STORAGE

A. Store railings in a dry, well-ventilated, weathertight place.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify railing dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 COORDINATION

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages. Deliver such items to Project site in time for installation.

1.9 SCHEDULING

A. Do not support railings temporarily by any means that does not satisfy structural performance requirements.

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:

1. Cable Railing Systems:

a. Hayn Lines.
b. C. Sherman Johnson Co.
c. Seco South.

2.2 METALS

A. General: Provide metal free from pitting, seam marks, roller marks, stains, discolorations, and other imperfections where exposed to view on finished units.

B. Steel and Iron: Provide steel and iron in the form indicated, complying with the following requirements:

1. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:

a. Black finish, unless otherwise indicated.
b. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.

2. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
3. Iron Castings: Malleable iron complying with ASTM A 47, Grade 32510.

C. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

D. Stainless Steel Cable and Fittings: Comply with the following:

1. Cable: Type 302, 1 x 19.
2. Swages, Barrels, and Stampings: Type 316
3. Miscellaneous Threaded Items: Type 304.

2.3 WELDING MATERIALS, FASTENERS, AND ANCHORS

A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

1. For steel railings, and fittings, use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

C. Cast-in-Place and Postinstalled Anchors: Anchors of type indicated below, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Cast-in-place anchors.
2. Chemical anchors.
3. Expansion anchors.

D. Cable Fittings and Anchors: Manufacturers standard stainless steel swages, barrels, turnbuckles, stampings, clevis pins and similar items required for complete installation of cable system as indicated.

2.4 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements in FS TT-P-664; selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

2.5 ANCHORING CEMENT

A. Interior Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Use for interior applications only.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Form changes in direction of railing members as follows:

1. As detailed.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of railing components.

E. Welded Connections: Fabricate railings for connecting members by welding. Cope components at perpendicular and skew connections to provide close fit, or use fittings designed for this purpose. Weld connections 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 flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

G. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

H. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

I. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

J. Cut, reinforce, drill, and tap components, as indicated, to receive finish hardware, screws, and similar items.

K. Provide weep holes or another means to drain entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

N. Provide machined swages at cable connections.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.8 STEEL FINISHES

A. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed railings:

1. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush-off Blast Cleaning."

D. Apply shop primer to prepared surfaces of railing components, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Stripe paint edges, corners, crevices, bolts, and welds.

2.9 STAINLESS STEEL FINISHES

A. Stainless Steel Finishes: Tumbled

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required to install railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free from rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated, but not less than that required by structural loads.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.3 ANCHORING POSTS

A. Core-drill holes as indicated for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's written instructions:

1. Anchor cement.

B. Anchor posts to metal surfaces by welding, unless noted otherwise.

3.4 CABLE RAILING SYSTEM INSTALLATION

A. Install cable railing system in accordance with manufacturer’s written installation instructions and as indicated. Provide welded tabs or other type connections as necessary for attachment of cable railing components.

3.5 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at the time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05521

SECTION 05580 - FORMED-METAL FABRICATIONS

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. Closures, including wall to window mullion closures.

B. Related Sections include the following:

1. Division 7 Section "Sheet Metal Flashing and Trim" for items made of formed metal for flashing purposes.

1.3 PERFORMANCE REQUIREMENTS

A. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Shop Drawings: Detail fabrication and installation of formed-metal fabrications. Include plans, elevations, sections, and details of components and their connections. Show anchorage and accessory items.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing formed-metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Source Limitations: Obtain formed-metal fabrications through one source from a single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver formed-metal fabrications wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.7 PROJECT CONDITIONS

A. Field Measurements: Where formed-metal fabrications are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 SHEET METAL

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Aluminum Sheet: Flat sheet complying with ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of alloy 5005-H15.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners: Use fasteners fabricated from same basic metal and alloy as fastened metal, unless otherwise indicated. Do not use metals that are corrosive or incompatible with materials joined.

1. Provide concealed fasteners for interconnecting formed-metal fabrications and for attaching them to other work, unless otherwise indicated.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble formed-metal fabrications in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of formed-metal fabrications with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned, unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness specified for stretcher-leveled sheet metal and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install formed-metal fabrications.

2.4 CLOSURES

A. Form closures from metal of type and thickness indicated below:

1. Aluminum Sheet: 0.0625 inch.

2.5 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Apply organic anodic finishes to formed metal after fabrication, unless otherwise indicated.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place formed-metal fabrications level, plumb, and in alignment with adjacent construction.

B. Use concealed anchorages where possible.

C. Form tight joints with exposed connections accurately fitted together.

D. Corrosion Protection: Coat concealed surfaces of aluminum, zinc-coated, and nonferrous metals that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 ADJUSTING

A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.3 PROTECTION

A. Protect finishes of formed-metal fabrications from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05580

SECTION 05811 - ARCHITECTURAL JOINT SYSTEMS

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. Types of joints for which architectural joint systems are specified include the following:

1. Exterior wall joints.
2. Interior pedestrian traffic joints.
3. Interior wall and ceiling joints.

1.3 DEFINITIONS

A. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (inches) or a percentage of nominal value of joint width.

B. Nominal Joint Width: Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.

1. Pedestrian Traffic Joints: Support pedestrian traffic across joint.
2. Exterior Joints: Maintain continuity of weather enclosure.
3. Seismic Joints: Remain in place on exposure to seismic activity (movement).
4. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

B. Shop Drawings: For each joint system specified, provide the following:

1. Placement Drawings: Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each exposed metal and elastomeric material of joint system indicated.

1. Include similar Samples of material for joints and accessories involving color selection.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain architectural joint systems through one source from a single manufacturer. Coordinate compatibility with adjoining joint systems specified in other Sections.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Other manufacturers' systems complying with requirements may be considered. Refer to Division 1 Section "Product 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: The design for each architectural joint system specified in Part 2 "Architectural Joint Systems" Article below is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers listed.

2.2 MATERIALS

A. Aluminum: ASTM B 221 , alloy 6063-T5 for extrusions; ASTM B 209 , alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Preformed Seals: Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors.

C. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 ARCHITECTURAL JOINT SYSTEMS

A. General: Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.

B. Architectural Joint System AJS-1: Metal frames and preformed seals for exterior joints on walls.

1. Basis-of-Design Product: SF Series; Conspec Systems Inc., or a comparable product of one of the following:

   a. MM Systems.
   b. Nystrom Building Products.

2. Nominal Joint Width: As indicated.
3. Movement Capability: 1.5 inches.
4. Type of Movement Capability: Expansion and contraction, and seismic.
5. Preformed Seal Material: Manufacturer's standard.

   a. Seal Color: Selected by Architect.

6. Exposed Frame Material: Aluminum.
7. Moisture Barrier: Provide manufacturer's standard unit.

C. Architectural Joint System AJS-2: Metal frames and preformed seals for interior joints on walls and ceilings.

1. Basis-of-Design Product: FWS Series; Conspec Systems Inc., or a comparable product of one of the following:

   a. MM Systems.
   b. Nystrom Building Products.

2. Nominal Joint Width: As indicated.
3. Movement Capability: 2 inches.
4. Type of Movement Capability: Expansion and contraction, and seismic.
5. Preformed Seal Material: Manufacturer's standard.

    a. Seal Color: Selected by Architect.

6. Exposed Frame Material: Aluminum.
7. Moisture Barrier: Provide manufacturer's standard unit.
8. Frame Flanges: Flanges designed to be embedded in drywall compound.

D. Architectural Joint System AJS-3: Metal frames and covers for interior traffic joints.

1. Basis-of-Design Product: PC Series; Conspec Systems Inc., or a comparable product of one of the following:

    a. MM Systems.
    b. Nystrom Building Products.

2. Nominal Joint Width: As indicated.
3. Movement Capability: 1.5 inches.
4. Type of Movement Capability: Expansion and contraction.
5. Exposed Cover Material: Aluminum.

E. Architectural Joint System AJS-4: Metal covers for interior traffic joints adjacent to walls.

1. Basis-of-Design Product: PCW Series; Conspec Systems Inc., or a comparable product of one of the following:

    a. MM Systems.
    b. Nystrom Building Products.

2. Nominal Joint Width: As indicated.
3. Movement Capability: 1.5 inches.
4. Type of Movement Capability: Expansion and contraction.
5. Exposed Cover Material: Aluminum.

2.4 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.

2.5 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Mill Finish: AA-M10 (Mechanical Finish: as fabricated; no other applied finish unless buffing is required to remove scratches, welding, or grinding produced in fabrication process.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to architectural joint system manufacturer's written instructions.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.

B. Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

C. Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.

D. Install factory-fabricated transitions between building expansion-joint cover assemblies and roof expansion-joint assemblies to provide continuous, uninterrupted, watertight construction.

E. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.

1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
4. Locate architectural joint system covers in continuous contact with adjacent surfaces.
5. Securely attach in place with required accessories.

6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

F. Continuity: Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

G. Extruded Preformed Seals: Install seals to comply with manufacturer's written instructions and with minimum number of end joints.

1. For straight sections, provide preformed seals in continuous lengths.
2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
4. Seal transitions according to manufacturer's written instructions.

H. Joint Systems with Seals: Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.

I. Seismic Seals: Install interior seals in continuous lengths. Install exterior seal in standard lengths and vulcanize or heat-weld field splice joints to provide watertight joints using manufacturer's recommended procedures. Seal transitions and end joints according to manufacturer's written instructions.

3.3 CLEANING AND PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

END OF SECTION 05811

SECTION 06100 - 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. Wood nailers, and blocking.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 9 Section “Gypsum Sheathing” for gypsum sheathing panels attached over metal studs, and air infiltration barriers.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:

1. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.
2. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

C. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.

D. Warranty of chemical treatment manufacturer for each type of treatment.

E. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence the following products' compliance with building code in effect for Project.

1. Power-driven fasteners.
2. Fire-retardant-treated wood.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber and provide for air circulation within and around stacks and under temporary coverings.

1. For lumber pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

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:

1. Fire-Retardant-Treated Materials, Interior Type A:

a. Chemical Specialties, Inc.
b. Hickson Corp.
c. Hoover Treated Wood Products, Inc.

2.2 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:

1. WWPA - Western Wood Products Association.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

D. 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.

1. Provide dressed lumber, S4S, unless otherwise indicated.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPA C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.

B. Interior Type A: For interior locations, nailers, curbs, and blocking used in conjunction with roofing and copings, and other covered exterior locations not exposed to weather, use chemical formulation that produces treated lumber with the following properties under conditions present after installation:

1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
3. Contact with treated wood does not promote corrosion of metal fasteners.

C. Inspect each piece of treated lumber after drying and discard damaged or defective pieces.

2.4 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, nailers, blocking, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Grade: No. 2 or better.

D. Species: Hem-fir; WWPA.

2.5 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, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of nailers, blocking, and similar supports to allow attachment of other construction.

D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following

1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
2. Published requirements of metal framing anchor manufacturer.

3.2 WOOD NAILERS AND BLOCKING

A. Install wood nailers and blocking where shown and where required for screeding or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

END OF SECTION 06100

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

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. Plastic-laminate cabinets.
2. Plastic-laminate countertops.
3. Shelving units.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood blocking, required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 8 Section "Flush Wood Doors."

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. Product Data: For medium-density fiberboard, particleboard, high-pressure decorative laminate, adhesive for bonding plastic laminate, thermoset decorative overlay, fire-retardant-treated materials, and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.

C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.

1. Plastic laminates.
2. Thermoset decorative overlays.

D. Product Certificates: Signed by manufacturers of woodwork certifying that products furnished comply with requirements.

E. Qualification Data: For firms and persons specified in "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.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed architectural woodwork 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. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1. Provide AWI certification labels or compliance certificate indicating that woodwork complies with requirements of grades specified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

1. Granite Mill and Fixture Co.
2. Huetter Mill and Cabinet Co.
3. Salt Lake Mill and Lumber Co.
4. Other mills with prior approval of DFCM.

2.2 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD and MD-Exterior Glue.
3. Particleboard: ANSI A208.1, Grade M-2 and M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1.

C. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

a. Formica Corporation.
b. Nevamar; International Paper
c. Wilsonart International; Div. of Premark International, Inc.

E. Adhesive for Bonding Plastic Laminate: Contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

D. Wire Pulls: Back mounted, 4 inches long, 5/16 inches in diameter.

E. Shelf Rests: BHMA A156.9, B04013.

F. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:

1. Box Drawer Slides: 100 lbf.

G. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

H. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

I. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 INSTALLATION MATERIALS

A. Anchors: Select material, type, size, and finish required for 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 sleeves for drilled-in-place anchors.

2.5 FABRICATION, GENERAL

A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

B. Complete fabrication, including assembly, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

C. Shop 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. Sand edges of cutouts to remove splinters and burrs.

2.6 PLASTIC-LAMINATE CABINETS

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.

B. Grade: Premium.

C. AWI Type of Cabinet Construction: Flush overlay.

D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: HGS.
2. Vertical Surfaces: VGS.
3. Edges: VGS.

E. Materials for Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative overlay.
2. Drawer Sides and Backs: Thermoset decorative overlay.
3. Drawer Bottoms: Thermoset decorative overlay.

F. Colors and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide Architect's selections from laminate manufacturer's full range of colors and finishes in the following categories:

a. Solid colors.

G. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.7 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.

B. Grade: Premium.

C. High-Pressure Decorative Laminate Grade: HGS.

D. Colors and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors and finishes in the following categories:

a. Solid colors.

E. Edge Treatment: Same as laminate cladding on horizontal surfaces.

F. Core Material: Particleboard or medium-density fiberboard.

G. Core Material at Sinks: Particleboard made with exterior glue, medium-density fiberboard made with exterior glue.

2.8 SHELVING UNITS

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.

B. Grade: Premium.

C. Shelving Units: Provide surface materials indicated below:

1. Shelving Units: Thermoset decorative overlay.
2. Edges: PVC flat edge strip adhered to edge, matching color of thermoset decorative overlay. Do not use “T” molding.

D. Colors and Finishes: Provide materials and products that result in colors and textures of exposed surfaces complying with the following requirements:

1. Provide Architect's selections from thermoset decorative overlay manufacturer's full range of colors.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation.

E. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with toggle bolts through metal framing behind wall finish.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to walls with adhesive.
3. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

G. Shelving Units: Install shelving units without distortion.

1. Install shelving units with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall shelving units through back, near top and bottom, at ends and not more than 16 inches o.c. with toggle bolts through metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; 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.

END OF SECTION 06402

SECTION 07210 - BUILDING INSULATION

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. Foundation wall insulation (supporting backfill).
2. Concealed building insulation.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 7 Section "EPDM Single-Ply Membrane Roofing" for insulation specified as part of roofing construction.
2. Division 9 Section indicated below for sound insulation installed as part of metal-framed wall and partition assemblies:

   a. "Gypsum Board Assemblies."

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of insulation product specified.

C. Research or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence compliance of foam-plastic insulations with building code in effect for Project.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.5 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 written instructions for handling, storing, and protecting 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 before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:

1. Extruded-Polystyrene Board Insulation:

a. Amoco Foam Products Company.
b. Dow Chemical Co.
c. UC Industries, Inc.; Owens-Corning Co.

2. Glass-Fiber Insulation:

a. CertainTeed Corporation.
b. Knauf Fiber Glass GmbH.
c. Owens-Corning Fiberglas Corporation.

2.2 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. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:

1. Type IV, 1.60-lb/cu. ft. minimum density at foundation wall insulation.
2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.

C. Unfaced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).

1. Mineral-Fiber Type: Fibers manufactured from glass.
2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

2.3 VAPOR RETARDERS

A. Foil/Scrim/Kraft Vapor Retarder: Fiberglass reinforcing sandwiched between 0.0003 inch outer layer of aluminum foil laminated to inner layer of 30 lb./3000 sq. ft. natural kraft, with permeance of 0.02 perms, and with maximum flame-spread and smoke-developed indices of 10 and 0, respectively, for exposed face.

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of 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 until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.

C. Extend insulation in thickness 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.

D. Apply single layer of insulation to produce thickness indicated.

3.4 INSTALLATION OF PERIMETER INSULATION

A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3.6 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

C. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

E. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.7 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 is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210

SECTION 07411 - METAL ROOF PANELS

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. Factory-formed and field-assembled, standing-seam metal roof panels.

B. Related Sections include the following:

1. Division 5 Section "Steel Deck" for steel roof deck supporting metal roof panels.

1.3 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight roofing system.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: Negative 1.57 lbf/sq. ft.
2. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

C. Water Penetration: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.
2. Negative Preload Test-Pressure Difference: 50 percent of design wind-uplift-pressure difference.

D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift resistance class indicated.

E. Seismic Performance: Provide metal roof panel assemblies capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

F. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

a. Flashing and trim.
b. Snow guards.

C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:

1. Metal Roof Panels: Include reports for air infiltration and water penetration.

F. Maintenance Data: For metal roof panels to include in maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
2. Surface: Smooth, flat finish.
3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings.

a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, Polyethylene-Faced Sheet: ASTM D 1970, 40 mils thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.

1. Available Products:

a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "A."
b. Grace, W. R. & Co.; Grace Ice and Water Shield.
c. Johns Manville International, Inc.; Roof Defender.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws and other suitable fasteners designed to withstand design loads.

2.5 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Radius Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and snapping panels together.

1. Available Manufacturers:

a. AEP-Span.
b. Berridge Manufacturing Company.
c. Una-Clad.

2. Material: Zinc-coated (galvanized) steel sheet, 0.0209 inch thick.

a. Exterior Finish: Fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

3. Batten: Same material, finish, and color as roof panels.
4. Clips: Floating to accommodate thermal movement.

a. Material: Zinc-coated (galvanized) steel sheet, thickness as recommended by manufacturer.

5. Panel Coverage: 12 inches.
6. Panel Height: 1.75 inches.
7. Uplift Rating: UL 90.

2.6 ACCESSORIES

A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, fasciae, clips, flashings and similar items. Match material and finish of metal roof panels, unless otherwise indicated.

B. Flashing and Trim: Formed from 0.0179-inch- thick, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, and fasciae. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring.

1. Seam-Mounted, Bar-Type Snow Guards: Stainless-steel rods or bars held in place by stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.

a. Stainless-Steel Finish: Mill.
b. Available Products:

1) LMCurbs; S-5! SnoFence.
2) Riddell & Company, Inc.; Snobar.
3) Snow Management Systems, a division of Contek, Inc.; Vermont Snowguard

2.7 FABRICATION

A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile for full length of panel.

C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Fabricate nonmoving seams in accessories with flat-lock seams.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply over entire roof, in shingle fashion to shed water, with end laps of

not less than 6 inches staggered 24 inches between courses. Support end laps over deck flutes as recommended by manufacturer. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.4 METAL ROOF PANEL INSTALLATION, GENERAL

A. General: Provide metal roof panels of full length from eave to eave, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted.
2. Flash and seal metal roof panels with weather closures at eaves and rakes.

3.5 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, seam covers, flashings, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed 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 weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

C. Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with clamps or set screws. Do not use fasteners that will penetrate metal roof panels. Locate where indicated on the drawings.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07411

SECTION 07412 - METAL WALL PANELS

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. Factory-formed and -assembled, honeycomb-core metal wall panels.

B. Related Sections include the following:

1. Division 7 Section "Sheet Metal Flashing and Trim" for copings, flashings, and other sheet metal work not part of metal wall panel assemblies.
2. Division 7 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITION

A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight system.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide metal wall panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft..

C. Water Penetration: No water penetration when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft..

1. Water Leakage: Uncontrolled water infiltrating the system from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

D. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:

a. Uniform pressure as indicated on Drawings.

2. Deflection Limits: Engineer metal wall panel assemblies to withstand test pressures with deflection no greater than 1/240 of the span and no evidence of material failure, structural distress, or permanent deformation exceeding 0.2 percent of the clear span.

a. Test Pressures: 150 percent of inward and outward wind-load design pressures.

E. Seismic Performance: Provide metal wall panel assemblies capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

F. Thermal Movements: Provide metal wall panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

a. Flashing and trim.

C. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.
2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

D. Maintenance Data: For metal wall panels to include in maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of metal wall panel through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal wall panels and are based on the specific system indicated. Refer to Division 1 Section "Product 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 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal wall panels from exposure to sunlight and high humidity, except to extent necessary for period of metal wall panel installation.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate metal wall panel assemblies with flashing, trim, and construction of adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including rupturing, cracking, or puncturing.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

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

2.2 PANEL MATERIALS

A. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Surface: Smooth, flat finish.
2. Exposed Finishes: Apply the following coating, as specified or indicated on Drawings.

a. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.

C. Panel Sealants:

1. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.

2.3 MISCELLANEOUS METAL FRAMING

A. Steel Sheet Components, General: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.

B. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch.
2. Depth: 7/8 inch.

C. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 HONEYCOMB-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and honeycomb-core material laminated or otherwise securely bonded, without use of contact adhesives or pinch rollers, to facing sheets during fabrication; with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Panel Performance:

a. Fatigue: No evidence of delamination, core cracking, or permanent bowing when tested to a 20-lbf/sq. ft. positive and negative wind load and with deflection of L/180 for 2 million cycles.
b. Autoclave: No delamination when exposed to 2-psi pressure at a temperature of 212 deg F for 2-1/2 hours.
c. Fire-Test-Response Characteristics: Class A according to ASTM E 108.

1) Flame-spread and smoke-developed indexes of not more than 5 and 30, respectively, when tested according to ASTM E 84.

B. Wrapped-Edge, Honeycomb-Core Metal Wall Panels: Formed with flush exterior panel facing wrapped over panel edges; designed for independent installation by mechanically attaching through extended panel edges to supports using concealed fasteners; with sealant joints.

1. Available Products:

a. Copper Sales Inc.; UNA-CORE Series 10 Calked Joint System.
b. Industrial Building Panels, Inc.; Honeycomb 1000 Series.
c. Protean Construction Products, Inc.; HC-100 Panel.

2. Facings: Fabricate panel with exterior and interior facings of same material and thickness.

a. Material: Aluminum sheet, 0.040 inch thick.
b. Exterior Facing Finish: Fluoropolymer.

1) Color: As selected by Architect from manufacturer's full range.

c. Interior Facing Finish: Manufacturer's standard primer or polyester.

3. Kraft-Paper Honeycomb Core: Manufacturer's standard phenolic-resin impregnated paper, with not less than 15 percent resin content by weight and chemically treated for fire resistance; with maximum 1/2-inch cell size.
4. Sealant: Manufacturer's standard silicone.
5. Panel Thickness: 1.0 inch.

2.6 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, sills, corner units, flashings, sealants, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

2.7 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
2. Fabricate wall panels with panel stiffeners as required to maintain fabrication tolerances and to withstand design loads.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Honeycomb-Core Metal Wall Panels: Fabricate panels using manufacturer's standard thermosetting structural adhesive in a lamination process that bonds panel under minimum 10-psi pressure. Use of contact adhesives with pinch-roll process is not acceptable.

1. Panel Bow Tolerance: Not more than 0.5 percent of panel width or length.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
3. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.8 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect painted 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

B. Miscellaneous Framing: Install base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

3.3 METAL WALL PANEL INSTALLATION, GENERAL

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal wall panels by torch is not permitted.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
4. Flash and seal metal wall panels with weather closures at eaves, and at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
5. Install screw fasteners in predrilled holes.
6. Locate and space fastenings in uniform vertical and horizontal alignment.
7. Install flashing and trim as metal wall panel work proceeds.
8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
10. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:

1. Aluminum Wall Panels: Type, material, size, and spacing as recommended by pane manufacturer.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal wall panel manufacturer.

D. Joint Sealers: Install joint fillers and sealants where indicated and where required for weatherproof performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.4 FACTORY-ASSEMBLED METAL WALL PANEL INSTALLATION

A. Honeycomb-Core Metal Wall Panels:

1. Wrapped-Edge Panels: Mechanically attach wall panels through extended edge of panels to supports using self-tapping fasteners. Seal joints with cylindrical sealant backing and sealant.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, corners, flashings, sealants, fillers, closure strips, and similar items.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal wall panel units within installed tolerance of 1/4 inch in 20 feet , nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07412

SECTION 07531 - EPDM SINGLE-PLY MEMBRANE ROOFING

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. Mechanically fastened sheet roofing.
2. Roof insulation.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
3. Division 15 for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 for definition of terms related to roofing work not otherwise defined in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General: Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. FM Listing: Provide sheet membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.

1. Roofing system shall comply with the following:

a. Fire/Windstorm Classification: Class 1A-90.

1.5 SUBMITTALS

A. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Include plans, sections, and details of the following:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.

C. Samples for Verification: Of the following products:

1. 12-by-12-inch square of sheet roofing, of color specified.
2. 12-by-12-inch square of roof insulation.

D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that the roofing system complies with requirements specified in the "Performance Requirements" Article. Upon request, submit evidence of meeting requirements.

F. 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.

G. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.

H. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

I. Maintenance Data: For roofing system to include in the maintenance manuals specified in Division 1.

J. Warranty: Sample copy of standard roofing system manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty.

K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing roofing similar to that required for this Project and who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product.

B. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and slopes indicated.

C. Preinstallation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Notify participants at least 5 working days before conference.

1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
4. Review loading limitations of deck during and after roofing.
5. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
6. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.
9. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements.

1.9 WARRANTY

A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Standard Roofing Manufacturer's Warranty: Submit a written warranty, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair leaks resulting from defects in materials or workmanship for the following warranty period:

1. Warranty Period: 15 years.

C. Special Project Warranty: Submit roofing Installer's labor and materials warranty, on the DFCM Roofing Contractor Guarantee Form, signed by Installer, covering Work of this Section, including membrane roofing, sheet flashing, roof insulation, and fasteners for the following warranty period:

1. Warranty Period: 5 years from date of Substantial Completion.

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:

1. EPDM Sheet:

   a. Carlisle Syntec Systems; Carlisle Corp.
   b. Firestone Building Products Co.
   c. Johns-Manville Roofing Systems.

2. Polyisocyanurate Board Insulation:

   a. Apache Products Co.
   b. Atlas Roofing Corporation.
   c. Celotex Corp. (The).

2.2 EPDM SHEET

A. EPDM Sheet: Uniform, flexible sheet formed from a terpolymer of ethylene-propylene-diene, complying with ASTM D 4637, Type 1, of the following grade, class, thickness, backing, and exposed face color:

   1. Grade and Class: Grade 1 or 2 and Class SR, scrim or fabric internal reinforced.
   2. Thickness: 60 mils, nominal.
   3. Backing: Unbacked.
   4. Exposed Face Color: Black.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with EPDM membrane roofing.

   1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- thick EPDM, uncured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive.

D. Splice Primer and Tape: Manufacturer's standard synthetic rubber polymer primer and 3-inch- wide minimum, butyl splice tape with release film.

E. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, in-seam

sealants, termination reglets, and other accessories recommended by roofing system manufacturer for intended use.

2.4 INSULATION MATERIALS

A. General: Provide preformed roof insulation boards that comply with requirements, selected from manufacturer's standard sizes and of thicknesses indicated.

1. Provide preformed, tapered insulation boards where indicated for sloping to drain. Fabricate with the following taper:

a. As indicated on Drawings.

2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

B. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents to comply with ASTM C 1289, classified by facer type as follows:

1. Facer Type: Type II, felt or glass-fiber mat on both major surfaces.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements.

B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

C. Verify that wood nailers are in place and secured and match thicknesses of insulation required.

D. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated and to Shop Drawings.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Attached Insulation: Install insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type indicated.

1. Fasten insulation according to requirements of FM's "Approval Guide" for specified Windstorm Resistance Classification and the insulation and roofing system manufacturers' written instructions.

3.4 MECHANICALLY FASTENED SHEET INSTALLATION

A. Install EPDM sheet over area to receive roofing according to roofing system manufacturer's written instructions. Unroll sheet and allow to relax for a minimum of 30 minutes.

B. Start installation of sheet in presence of roofing system manufacturer's technical personnel.

C. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically or adhesively fasten sheet securely at terminations and perimeter of roofing.

E. Apply roofing sheet with side laps shingled with slope of roof deck where possible.

F. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing sheet in place with clamping ring.

G. In-Splice Attachment: Secure one edge of the sheet using fastening plates centered within the membrane splice and mechanically fasten sheet to roof deck. Field-splice seam according to "Seam Installation" Article.

3.5 SEAM INSTALLATION

A. Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet terminations.

B. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

3.6 FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing as recommended by manufacturer.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a

watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate sheet flashings as indicated.

3.7 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect or Owner 48 hours in advance of the date and time of inspection.

3.8 PROTECTING AND CLEANING

A. Protect sheet membrane roofing from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

END OF SECTION 07531

SECTION 07620 - SHEET METAL FLASHING AND TRIM

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 sheet metal flashing and trim in the following categories:

1. Copings.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 4 Sections for through-wall flashing and other integral masonry flashings specified as part of masonry work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone:

1. Wind Zone 1: Wind pressures of 21 to 30 psf.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.

1. 8-inch- square Samples of specified sheet materials to be exposed as finished surfaces.

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.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

A. Coil-Coated Galvanized Steel Sheet: Zinc-coated, commercial-quality steel sheet conforming to ASTM A 755, G 90 coating designation, coil coated with high-performance fluoropolymer coating as specified in "Coil-Coated Galvanized Steel Sheet Finish" Article; not less than 0.0336 inch thick, unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

B. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.

C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

D. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.

E. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

2.3 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams

E. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

F. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

G. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

H. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.4 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Copings: Fabricate from the following material:

1. Coil-Coated Galvanized Steel: 0.0396 inch thick.

2.5 COIL-COATED GALVANIZED STEEL SHEET FINISH

A. High-Performance Organic Coating Finish: Apply the following system by coil-coating process on galvanized steel sheet as recommended by coating manufacturers and applicator.

1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.

a. Color and Gloss: As selected by Architect from manufacturer's full range of choices for color and gloss.
b. Resin Manufacturers: Subject to compliance with requirements, provide fluoropolymer coating systems containing resins produced by one of the following manufacturers:

1) Ausimont USA, Inc. (Hylar 5000)
2) Elf Atochem North America, Inc. (Kynar 500)

2. Coil-Coated Steel Sheet Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

a. Atas Aluminum Corporation.
b. MM Systems Corporation.
c. Petersen Aluminum Corporation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "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.

B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in wa-

terproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

D. Do not solder coil-coated galvanized steel sheet.

E. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams

F. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

1. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07620

SECTION 07841 - THROUGH-PENETRATION FIRESTOP SYSTEMS

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 through-penetration firestop systems for penetrations through the following assemblies:

1. Floors.
2. Fire-Resistance-Rated Walls.

B. Related Sections include the following:

1. Division 15 Sections specifying duct and piping penetrations.
2. Division 16 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are 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 assembly penetrated.

1. Fire-resistance-rated walls.
2. Floor assemblies.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside wall cavities.
2. Penetrations located outside fire-resistive shaft enclosures.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

C. Qualification Data: For firms and persons specified in "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.

D. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems 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. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:.

a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

1) UL in "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system 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 materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application in the Through-Penetration Firestop System Schedule at the end of Part 3.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

   a. Slag-/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.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

H. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to pro-

duce products of uniform quality with optimum performance characteristics for application indicated.

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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing 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, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems 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 Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestop Systems for Metallic Pipes, Conduit, or Tubing: Comply with the following:

1. Available UL-Classified Systems: C-AJ- C-BJ- F-A- W-J- W-L- 1000-1999.
2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Mortar.

C. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing: Comply with the following:

1. Available UL-Classified Systems: C-AJ- C-BJ- F-A- W-J- W-L- 2000-2999.
2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Intumescent putty.
d. Intumescent wrap strips.
e. Firestop device.

D. Firestop Systems for Insulated Pipes: Comply with the following:

1. Available UL-Classified Systems: C-AJ- C-BJ- F-A- W-J- W-L- 5000-5999.
2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Intumescent putty.
c. Silicone foam.
d. Intumescent wrap strips.

E. Firestop Systems for Miscellaneous Mechanical Penetrations: Comply with the following:

1. Available UL-Classified Systems: C-AJ- W-J- W-L- 7000-7999.
2. Type of Fill Materials: One or both of the following:

   a. Latex sealant.
   b. Mortar.

END OF SECTION 07841

SECTION 07920 - JOINT SEALANTS

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 sealants for the following applications, including those specified by reference to this Section:

B. This Section includes sealants for the following applications:

1. Exterior joints in the following vertical surfaces:

    a. Perimeter joints between building materials and frames of doors and windows.
    b. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

    a. Perimeter joints of exterior openings where indicated.
    b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
    c. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    d. Joints between countertop backsplashes and walls.
    e. Other joints as indicated.

3. Interior joints in the following horizontal traffic surfaces:

    a. Control, isolation, and expansion joints in cast-in-place concrete slabs.
    b. Control and expansion joints in tile flooring.
    c. Other joints as indicated.

C. Related Sections include the following:

1. Division 2 Section "Pavement Joint Sealants" for sealing joints in walks and curbing.
2. Division 7 Section "Through-Penetration Firestop Systems"" for fire-resistant building joint-sealant systems.
3. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Qualification Data: For firms and persons specified in "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.

D. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

1.6 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 date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

A. General Warranty: 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. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, 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 of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.5 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. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape 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.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from 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 joint substrates and adjacent nonporous surfaces in any way, 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.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions 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 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. Porous joint surfaces include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean 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.

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. 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 written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

   a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint 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 and from damage resulting from construction operations or other causes so sealants 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 installations with repaired areas are indistinguishable from the original work.

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Mildew-Resistant Silicone Sealant: Provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:

1. Products: Available products include the following:

   a. 786 Mildew Resistant; Dow Corning.
   b. Sanitary 1700; GE Silicones.
   c. Tremsil 600 White; Tremco.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

   a. Use O Joint Substrates: Ceramic tile.

6. Applications Include the Following: Interior joints in surfaces of ceramic tile in toilet rooms, around plumbing fixtures and grab bar anchorages, joints between countertop backsplashes and walls.

B. Multicomponent Pourable Urethane Sealant: Provide products complying with the following:

1. Products: Available products include the following:
   a. Vulkem 255; Mameco International.
   b. Sikaflex - 2c SL; Sika Corporation.
   c. THC-900; Tremco.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

   a. Use O Joint Substrates: Aluminum or steel with high-performance coatings.

6. Applications Include the Following: Interior joints in horizontal surfaces of concrete.

C. Multicomponent Nonsag Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:

   a. Vulkem 922; Mameco International.

b. Sikaflex - 2c NS; Sika Corporation.
c. DYmeric 511; Tremco.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
5. Use Related to Exposure: NT (nontraffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
7. Use O Joint Substrates: Color anodic aluminum, galvanized steel, brick, ceramic tile.
8. Applications Include the Following: Exterior and interior joints in vertical and horizontal surfaces of masonry; between metal and masonry or mortar; interior and exterior perimeter joints of metal frames in exterior walls.

3.7 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant: Provide products complying with the following:

1. Products: Available products include the following:

a. Chem-Calk 600; Bostik Inc.
b. AC-20; Pecora Corporation.
c. Tremflex 834; Tremco.

2. Applications Include the Following: Perimeter of hollow metal door and window frames in gypsum drywall.

END OF SECTION 07920

SECTION 08111 - STEEL DOORS AND FRAMES

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. Steel door frames.
2. Fire-rated steel door frames.
3. Sidelight, transom, and borrowed light frames.

B. Related Sections include the following:

1. Division 8 Section "Flush Wood Doors" for wood doors installed in steel frames.
2. Division 8 Section "Door Hardware" for door hardware, silencers, and weather stripping.
3. Division 9 Section "Painting" for field painting factory-primed door frames.

1.3 DEFINITIONS

A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.4 SUBMITTALS

A. Product Data: For each type of door frame indicated, include door designation, type, material description, construction details, label compliance, fire-resistance ratings, and finishes.

B. Shop Drawings: Show the following:

1. Frame details for each frame type including dimensioned profiles.
2. Details and locations of reinforcement and preparations for hardware.
3. Details of each different wall opening condition.
4. Details of anchorages, accessories, joints, and connections.

C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for door frames.

1.5 QUALITY ASSURANCE

A. Steel Door Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at positive pressure in accordance with UBC Standard 7-2 and U.L. 10C.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver door frames cardboard-wrapped or crated to provide protection during transit and job storage.

B. Inspect door frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

C. Store door frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If packaging becomes wet, remove cartons immediately.

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:

1. Steel Door Frames:

a. Ceco Door Products; a United Dominion Company.
b. Curries Company.
c. Steelcraft; a division of Ingersoll-Rand.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of flatness where used for face sheets.

2.3 FRAMES

A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Frames of 0.053-inch- thick steel sheet for:

1. Wood doors.

C. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

D. Supports and Anchors: Fabricated from not less than 0.042-inch- thick, electrolytic zinc-coated or metallic-coated steel sheet.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.4 FABRICATION

A. General: Fabricate steel frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

B. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

C. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

D. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

E. Hardware Preparation: Prepare door frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door frame preparation for hardware.

F. Frame Construction: Fabricate frames to shape shown.

1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
2. Provide welded frames with temporary spreader bars.

G. Reinforce door frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

H. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.5 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel door frames and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Place frames before construction of enclosing walls and ceilings.
2. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

3. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
4. Install fire-rated frames according to NFPA 80.

3.2 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from door frames.

END OF SECTION 08111

SECTION 08211 - FLUSH WOOD DOORS

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. Solid-core doors with wood-veneer, faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.3 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate doors to be factory finished and finish requirements.

C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:

1. Faces of Factory-Finished Doors: Show the full range of colors available for stained finishes.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality Standard: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated."

1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: After 5 minutes into the test, the neutral pressure level in furnace shall be established at 40 inches or less above the sill.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall be in effect during the following period of time from date of Substantial Completion:

a. Solid-Core Interior Doors: Life of installation.

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:

1. Flush Wood Doors:

a. GRAHAM Manufacturing Corp.
b. VT Industries Inc.
c. Weyerhaeuser Company.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish:

1. Grade: Custom, with Grade A faces.
2. Species and Cut: Red oak, plain sliced.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces: Balance match.

2.3 SOLID-CORE DOORS

A. Particleboard Cores: Comply with the following requirements:

1. Particleboard: ANSI A208.1, Grade LD-2.
2. Provide doors with either glued-block or structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.

B. Interior Veneer-Faced Doors:

1. Core: Particleboard.
2. Construction: Five (PC-5) or seven (PC-7) plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as needed to provide fire rating indicated.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance.
4. Pairs: Provide fire-rated pairs with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.

2.4 LIGHT FRAMES

A. Metal Frames for Light Openings in Doors: Manufacturer's standard frame formed of 0.0478-inch- thick, cold-rolled steel sheet; factory primed. In fire rated doors, provide frames approved for use in doors of fire rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2.6 FACTORY FINISHING

A. General: Comply with AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.

B. Finish doors at factory.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-6 catalyzed polyurethane.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08211

SECTION 08411 - ALUMINUM ENTRANCES AND STOREFRONTS

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. Exterior entrance systems.

B. Related sections include the following:

1. Division 8 Section "Power Door Operators."
2. Division 8 Section “Door Hardware” for aluminum entrance hardware not specified in this Section.
3. Division 8 Section "Glazing."
4. Division 8 Section "Glazed Aluminum Curtain Walls."

1.3 SYSTEM DESCRIPTION

A. General: Provide aluminum entrance systems capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:

1. Air infiltration and water penetration exceeding specified limits.
2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.

B. Glazing: Physically and thermally isolate glazing from framing members.

C. Wind Loads: Provide entrance systems, including anchorage, capable of withstanding wind-loads indicated on structural drawings.

1. Deflection of framing members in a direction normal to wall plane is limited to 1/175 of clear span or 3/4 inch, whichever is smaller, unless otherwise indicated.
2. Static-Pressure Test Performance: Provide entrance systems that do not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.

a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
b. Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.

D. Seismic Loads: Provide entrance systems, including anchorage, capable of withstanding the effects of earthquake motions calculated according to indicated requirements.

E. Live Loads: Provide entrance systems, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

F. Air Infiltration: Provide entrance systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft.

G. Thermal Movements: Provide entrance systems, including anchorage, that accommodate thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

H. Structural-Support Movement: Provide entrance systems that accommodate structural movements including, but not limited to, sway and deflection.

I. Dimensional Tolerances: Provide entrance systems that accommodate dimensional tolerances of building frame and other adjacent construction.

1.4 SUBMITTALS

A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: For entrance systems. Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.

1. For entrance systems, include hardware schedule and indicate operating hardware types, quantities, and locations.

C. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of entrance systems with requirements based on comprehensive testing of current systems.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance systems similar to those required for this Project and who is acceptable to manufacturer.

1. Engineering Responsibility: Prepare data for entrance systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Source Limitations: Obtain each type of entrance system through one source from a single manufacturer.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures.
2. Failure of system to meet performance requirements.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Failure of operating components to function normally.
5. Water leakage through fixed glazing and frame areas.

C. Warranty Period: 2 years from date of Substantial Completion.

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:

1. Butler Manufacturing Company; Vistawall Architectural Products.
2. EFCO Corporation.
3. U.S. Aluminum.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
3. Bars, Rods, and Wire: ASTM B 211.

B. Glazing as specified in Division 8 Section "Glazing."

C. Glazing Gaskets: Manufacturer's standard pressure-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. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

2.3 COMPONENTS

A. Doors: Provide manufacturer's standard 1-3/4-inch- thick glazed doors with minimum 0.125-inch- thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.

1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.
2. Stile Design: Medium stile; 3-1/2-inch nominal width.

B. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Reinforce members as required to retain fastener threads.
2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.

D. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:

1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.

2.4 HARDWARE

A. General: 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.

B. Continuous Gear Hinges: Manufacturer's standard, continuous, aluminum gear hinges.

C. Door Stops: ANSI/BHMA A156.16, Grade 1, floor- or wall-mounted door stop, as appropriate for door location indicated, with integral rubber bumper.

D. Pull Handles: As selected by Architect from manufacturer's full range of pull handles and plates.

E. Thresholds: At exterior doors, provide manufacturer's standard threshold with cutouts coordinated for operating hardware, with anchors and jamb clips, and not more than 1/2-inch- high, with beveled edges providing a floor level change with a slope of not more than 1:2, and in the following material:

1. Material: Aluminum, mill finish.

F. Weather Sweeps: Manufacturer's standard weather sweep for application to exterior door bottoms and with concealed fasteners on mounting strips.

2.5 FABRICATION

A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Prepare components to receive concealed fasteners and anchor and connection devices.

D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.

E. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."

F. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.

1. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.

2.6 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

B. Install entrances plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.

1. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.

C. Install glazing to comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.

B. Remove excess dirt from surfaces.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08411

SECTION 08711 - 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 the following:

1. Commercial door hardware for the following:

a. Swinging doors.

2. Electrified door hardware.

B. Related Sections include the following:

1. Division 8 Section "Aluminum Entrances and Storefronts" for entrance door hardware not specified in this Section.
2. Division 8 Section "Power Door Operators" for automatic door operators.

1.3 SUBMITTALS

A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. System schematic.
b. Point-to-point wiring diagram.
c. Riser diagram.
d. Elevation of each door.

2. Detail interface between electrified door hardware and fire alarm and access control systems.

C. 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.

    a. Organize door hardware sets in same order as in the Door Hardware Schedule at the end of Part 3.

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 each 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. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

        1) Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.

D. Keying Schedule: Prepared by or under the supervision of supplier, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

E. Product Certificates: Signed by manufacturers of electrified door hardware certifying that products furnished comply with requirements.

1. Certify that door hardware approved for use on types and sizes of labeled fire doors complies with listed fire door assemblies, if any.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

1. Include lists of completed projects with project names and addresses of architects and owners, and other information specified.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating current products comply with requirements.

H. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 1.

I. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware installation 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. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Electrified Door Hardware Supplier Qualifications: An experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance, and who is acceptable to manufacturer of primary materials.

a. Engineering Responsibility: Prepare data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.

1. Electrified Door Hardware Qualifications: Experienced in providing consulting services for electrified door hardware installations.

D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that are listed to perform

electrical modifications, by a testing and inspecting agency acceptable to authorities having jurisdiction, are acceptable.

E. Regulatory Requirements: Comply with provisions of the following:

1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG),"and ANSI A117.1, as follows:

   a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
   b. Door Closers: Comply with the following maximum opening-force requirements indicated:

      1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      2) Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
      3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

   c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

2. NFPA 101: Comply with the following for means of egress doors:

   a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
   b. Door Closers: Not more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
   c. Thresholds: Not more than 1/2 inch high.

3. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Test Pressure: Test at positive pressure in accordance with NFPA 252.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

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 keys to Owner by registered mail or overnight package service.

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 door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies access control system .

1.7 WARRANTY

A. General Warranty: 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. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of operators and door hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

C. Warranty Period: Two years from date of Substantial Completion, unless otherwise indicated.

D. Warranty Period for Manual Closers: 10 years from date of Substantial Completion.

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 this Section, and the Door Hardware Schedule at the end of Part 3.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule 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 minimum requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

2.2 HINGES

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:

1. Hinges:

a. Hager Companies (HA).
b. McKinney Products Company; Div. of ESSEX Industries, Inc. (MC).
c. Stanley Commercial Hardware; Div. of The Stanley Works (ST).

B. Standards: Comply with the following:

1. Butts and Hinges: BHMA A156.1.
2. Template Hinge Dimensions: BHMA A156.7.

C. Quantity: Provide the following, unless otherwise indicated:

1. Three Hinges: For doors with heights 61 to 90 inches.

D. Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

		Metal Thickness (inches)	
Maximum Door Size (inches)	Hinge Height	Standard Weight	Heavy Weight

	(inches)		
36 by 84 by 1-3/4	4-1/2	0.134	0.180

E. Template Requirements: Provide only template-produced units.

F. Hinge Weight: Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.

G. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Steel, with steel pin.
2. Interior Hinges: Steel, with steel pin.
3. Hinges for Fire-Rated Assemblies: Steel, with steel pin.

H. Hinge Options: Comply with the following where indicated in the Door Hardware Schedule or on Drawings:

1. Nonremovable Pins: 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 following applications:

   a. Outswinging exterior doors.
   b. Outswinging interior doors with locks.
   c. Where indicated.

I. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Wood Screws: For wood doors.
3. Screws: Phillips flat-head screws; machine screws (drilled and tapped holes) for metal doors, wood screws for wood doors. Finish screw heads to match surface of hinges.

2.3 LOCKS AND LATCHES

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:

1. Mechanical Locks and Latches:

   a. Best Lock Corporation (BL).

b. Sargent Manufacturing Company; Div. of ESSEX Industries, Inc. (SA).
c. Schlage Lock Company; an Ingersoll-Rand Company (SC).

B. Standards: Comply with the following:

1. Mortise Locks and Latches: BHMA A156.13.

C. Mortise Locks: Stamped steel case with steel or brass parts; BHMA Grade 1; Series 1000.

D. Certified Products: Provide door hardware listed in the following BHMA directories:

1. Mechanical Locks and Latches: BHMA's "Directory of Certified Locks & Latches."

E. Lock Trim: Comply with the following:

1. Lever: Forged, or cast.
2. Escutcheon (Rose): Wrought or forged.
3. Lockset Designs: Provide the lockset design designated below or, if sets are provided by another manufacturer, provide designs that match those designated:

F. Lock Functions: Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:

1. Mortise Locks: BHMA A156.13.

G. Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:

1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
2. Deadbolts: Minimum 1-inch bolt throw.

H. Backset: 2-3/4 inches, unless otherwise indicated.

2.4 EXIT DEVICES

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:

1. Precision Hardware, Inc. (PH).
2. Sargent Manufacturing Company; Div. of ESSEX Industries, Inc. (SA).
3. Von Duprin; an Ingersoll-Rand Company (VD).

B. Standard: BHMA A156.3.

1. BHMA Grade: Grade 1.

C. Certified Products: Provide exit devices listed in BHMA's "Directory of Certified Exit Devices."

D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

E. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

2.5 CYLINDERS AND KEYING

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:

1. Cylinders: Match existing system.

B. Standards: Comply with the following:

1. Cylinders: BHMA A156.5.

C. Cylinder Grade: BHMA Grade 1.

D. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Six.
2. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
3. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

E. Construction Keying: Comply with the following:

1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

F. Keying System: Unless otherwise indicated, provide a factory-registered keying system complying with the following requirements:

1. Key System: Match existing system. Comply with Owner’s requirements.

G. Keys: Provide nickel-silver keys complying with the following:

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2. Quantity: In addition to one extra blank key for each lock, provide the following:

a. Cylinder Change Keys: Three per change.
b. Master Keys: Five.

2.6 STRIKES

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:

1. Electric Strikes:

a. Folger Adam Security Inc. (FA).
b. Hess (HE).
c. Von Duprin, Inc.; an Ingersoll-Rand Company (VD).

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Dustproof Strikes: BHMA A156.16.
3. Electric Strikes: BHMA A156.5.

C. 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.

D. Electric Strikes: BHMA Grade 1.

2.7 OPERATING TRIM

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:

1. Ives: H. B. Ives (IV).
2. Rockwood Manufacturing Company (RO).
3. Triangle Brass Manufacturing Company, Inc. (TB).

B. Standard: Comply with BHMA A156.6.

C. Materials: Fabricate from stainless steel, unless otherwise indicated.

2.8 ACCESSORIES FOR PAIRS OF DOORS

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:

1. Removable Mullions:

a. Sargent Manufacturing Company; Div. of ESSEX Industries, Inc. (SA).
b. Von Duprin; an Ingersoll-Rand Company (VD).
c. Yale Security Inc.; Div. of Williams Holdings (YA).

2.9 CLOSERS

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:

1. Surface-Mounted Closers:

a. LCN Closers; an Ingersoll-Rand Company (LC).
b. Norton Door Controls; Div. of Yale Security Inc. (ND).
c. Sargent Manufacturing Company; Div. of ESSEX Industries, Inc. (SA).

B. Standards: Comply with the following:

1. Closers: BHMA A156.4.

C. Surface Closers: BHMA Grade 1.

D. Certified Products: Provide door closers listed in BHMA's "Directory of Certified Door Closers."

E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.10 PROTECTIVE TRIM UNITS

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:

1. Metal Protective Trim Units:

a. Hager Companies (HA).
b. Ives: H. B. Ives (IV).
c. Rockwood Manufacturing Company (RO).

B. Standard: Comply with BHMA A156.6.

C. Materials: Fabricate protection plates from the following:

1. Stainless Steel: 0.050 inch thick; beveled top and 2 sides.

D. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine or self-tapping screws.

2.11 STOPS AND HOLDERS

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:

1. Quality Hardware (QU)
2. Rockwood Manufacturing Company (RO).
3. Triangle Brass Manufacturing Company, Inc. (TB).

B. Standards: Comply with the following:

1. Stops and Bumpers: BHMA A156.16.
2. Door Silencers: BHMA A156.16.

C. Stops and Bumpers: BHMA Grade 1.

D. Silencers for Metal Door Frames: BHMA Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

2.12 DOOR GASKETING

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:

1. Door Gasketing:

a. National Guard Products, Inc. (NG).
b. Pemko Manufacturing Co., Inc. (PE).
c. Zero International, Inc. (ZR).

B. Standard: Comply with BHMA A156.22.

C. General: Provide continuous gasketing on doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

D. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.

E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL 10B or NFPA 252.

F. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

G. Gasketing Materials: Comply with ASTM D 2000 and AAMA 701/702.

2.13 MISCELLANEOUS DOOR HARDWARE

A. Standard: Comply with the following:

1. Auxiliary Hardware: BHMA A156.16.

B. Auxiliary Hardware: BHMA Grade 1, unless otherwise indicated.

C. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended.

Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Steel Machine or Wood Screws: For the following fire-rated applications:

    a. Mortise hinges to doors.
    b. Strike plates to frames.
    c. Closers to doors and frames.

3. Steel Through Bolts: For the following fire-rated applications, unless door blocking is provided:

    a. Surface hinges to doors.
    b. Closers to doors and frames.
    c. Surface-mounted exit devices.

4. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.15 FINISHES

A. Standard: Comply with BHMA A156.18.

B. 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 doors and frames, 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. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: Comply with DHI A115 series.

1. Surface-Applied Door Hardware: Drill and tap doors and frames according to SDI 107.

B. Wood Doors: Comply with DHI A115-W series.

3.3 INSTALLATION

A. 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."

B. Install each door hardware item to comply with manufacturer's 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.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

1. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.

3.4 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.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.7 DOOR HARDWARE SCHEDULE

H1

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Exit Device	SA	8813 ETL	26D
(1) Ea Keypad	By others		
(1) Ea Electric Strike	HS	9600 x 2505	32D
(1) Ea Closer	SA	351-UO	PEN
(1) Ea Wall Stop	RO	409	32D
(1) Ea Kickplate	RO	10” x 2” LDW	32D
(3) Ea Silencers	RO	608	Grey
(1) Ea Power Supply	SE	BPS-24	

H2

(3) Ea Hinges	MC	TA 2714 4 ½” x 4 ½”	26D
(1) Ea Lockset	SA	8204 LNJ	26D
(1) Ea Card Reader	By others		
(1) Ea Electric Strike	HS	1006 x 2505	32D
(1) Ea Closer	SA	351-UO	PEN
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey
(1) Ea Power Supply	SE	BPS -24	

H3

(6) Ea Hinges	MC	TA2714 4 ½” x 4 ½” NRP	26D
(1) Ea Exit Device	SA	8813 ETJ	26D
(1) Ea Exit Device	SA	8810 x 710 ETJ	26D
(1) Ea Card Reader	by Others		
(2) Ea Closers	SA	351 x 25CPS	PEN
(1) Ea Electric Strike	HS	9600 x 2505	32D
(2) Ea Kickplates	RO	10” x 2” LDW	32D
(1) Ea Removable Mullion	SA	EL980	USP
(2) Ea Silencers	RO	608	Grey
(1) Ea Power Supply	SE	BPS-24	

H4

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½” NRP	26D
(1) Ea Exit Device	SA	8813ETJ	26D
(1) Ea Card Reader	By others		
(1) Ea Electric Strike	HS	9600 x 2505	32D
(1) Ea Closer	SA	351 x 25CPS	PEN
(1) Ea Kickplate	RO	10” x 2” LDW	32D
(3) Ea Silencers	RO	608	Grey
(1) Ea Power Supply	SE	BPS-24	

H5

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Classroom Lock	SA	8237 LNJ	26D
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey

H6

(3) Ea Hinges	MC	TA2714 4 ½ x 4 ½”	26D
(1) Ea Passage Set	SA	8215 LNJ	26D
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey

H7

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Storeroom Lock	SA	8204 LNJ	26D
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey

H8

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Exit Device	SA	8813ETJ	26D

(1) Ea Card Reader	By others		
(1) Ea Electric Strike	HS	9600 x 2505	32D
(1) Ea Closer	SA	351 UO	PEN
(1) Ea Wall Stop	RO	409	32D
(1) Ea Kickplate	RO	10” x 2” LDW	32D
(3) Ea Silencers	RO	608	Grey
(1) Ea Power Supply	SE	BPS-24	

H9

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½” NRP	26D
(1) Ea Exit Device	SA	8813 ETJ	26D
(1) Ea Closer	SA	351 UO	PEN
(1) Ea Wall Stop	RO	409	32D
(1) Ea Kickplate	RO	10” x 2” LDW	32D
(3) Ea Silencers	RO	608	Grey

H10

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Lockset	SA	8205 LNJ	26D
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey

H11

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Passage	SA	8215 LNJ	26D
(1) Ea Closer	SA	351 UO	PEN
(1) Ea Wall Stop	RO	409	32D
(1) Ea Kickplate	RO	10” x 2” LDW	32D
(3) Ea Silencers	RO	608	Grey

H12

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½” NRP	26D
(1) Ea Lockset	SA	8204 LNJ	26D
(1) Ea Closer	SA	351 UH	PEN
(1) Ea Kickplate	RO	10” x 2” LDW	32D
(3) Ea Silencers	RO	608	Grey

H13

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Office Lock	SA	8205 LNJ	26D
(1) Ea Closer	SA	351-UO	PEN
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey

H14

(1) Ea Exit Device	SA	56-8513 ETL	26D
(1) Ea Exit Device	SA	8510 x 710 ETL	26D
(1) Ea Closer	SA	351 x 25CPS	PEN
(1) Ea Drop Plate	SA	350D	PEN
(1) Ea Power Transfer	SE	TSB-C	
(1) Ea Removable Mullion	SA	980A	PEN
(1) Ea Card Reader	By others		
(1) Ea Power Supply	SE	BPS-24	

Manufacturers standard hinges, threshold and weatherstripping.

H15

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½” NRP	26D
(1) Ea Exit Device	SA	8813ETJ	26D
(1) Ea Card Reader	By others		
(1) Ea Electric Strike	HS	9600 x 2505	32D
(1) Ea Closer	SA	351 UO	PEN
(1) Ea Wall Stop	RO	409	32D
(1) Ea Kickplate	RO	10” x 2” LDW	32D
(3) Ea Silencers	RO	608	Grey
(1) Ea Power Supply	SE	BPS-24	

H16

(6) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(2) Ea Exit Device	SA	8815 ETJ	26D
(2) Ea Closers	SA	351 UO	PEN
(2) Ea Wall Stops	RO	409	32D
(2) Ea Silencer	RO	608	Grey
(1) Ea Removable Mullion	SA	L980	USP

H17

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Privacy Set	SA	8265 LNJ	26D
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey

H18

(3) Ea Hinges	MC	TA2714 4 ½” x 4 ½”	26D
(1) Ea Passage Set	SA	8215 LNJ	26D
(1) Ea Closer	SA	351 UO	PEN
(1) Ea Wall Stop	RO	409	32D
(3) Ea Silencers	RO	608	Grey

H19

(1) Ea Exit Device	SA	56-8513 ETL	26D
(1) Ea Exit Device	SA	8510 x 710 ETL	26D
(1) Ea Closer	SA	351 x 25CPS	PEN
(1) Ea Drop Plate	SA	350D	PEN
(1) Ea Power Transfer	SE	TSB-C	
(1) Ea Removable Mullion	SA	980A	PEN
(1) Ea Card Reader	By others		
(1) Ea Auto Operator	By others		
(1) Ea Power Supply	SE	BPS-24	

Manufacturers standard hinges, threshold and weatherstripping.

H20

(6) Ea Hinges	MC	TA2714 4 ½" x 4 ½" NRP	26D
(2) Ea Exit Device	VD	99LF x 06	26D
(2) Ea Rim Cylinders	SA	34	26D
(2) Ea Closers	SA	351 UO	26D
(1) Ea Card Reader	By others		
(1) Ea Electric Strike	VD	6111	32D
(2) Ea Kickplates	RO	10" x 2" LDW	32D
(1) Ea Power Supply	SE	BPS-24	
(1) St Smoke Seal	PE	PK55 LAR	D
(2) Ea Sweeps	PE	315CN LAR	AL
(1) St Meeting Stiles	PE	303CS LAR	AL

H21

(3) Ea Hinges	MC	TA2714 4 ½" x 4 ½"	26D
(1) Ea Exit Device	SA	55-8815 ETJ	26D
(1) Ea Closer	SA	351UO	EN
(1) Ea Mag Lock	SE	32SC	
(2) Ea Card Readers	By others		
(1) Ea Horn	SA	4380H	
(1) Ea Power Transfer	SE	EPT	
(1) Ea Power Supply	SE	BPS 24	

Match Existing Sargent Key System.

END OF SECTION 08711

SECTION 08716 - POWER DOOR OPERATORS

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. Power door operators for one-way swinging doors.

B. Related Sections include the following:

1. Division 16 Sections for electrical power and connections.

1.3 SUBMITTALS

A. Product Data: For each door operator type required. Include manufacturer's standard details, fabrication methods, and published recommendations for each component of the door operating system required, and the following:

1. Roughing-in diagrams.
2. Certified performance reports.
3. Installation instructions.
4. Parts lists.

B. Wiring Diagrams: Detail wiring for power operator, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: For power door operators to include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the product manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than 2 hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing operators similar to those indicated for this Project and with a record of successful in-service performance.

C. BHMA Standard: Provide power door operators that comply with applicable requirements of BHMA A156.19, "Power Assist and Low Energy Power Operated Doors."

D. UL Standard: Provide power door operators that comply with UL 325.

E. Emergency-Exit Openings: Provide door operators that comply with NFPA 80 requirements for doors as emergency exits.

1.5 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace components of the power door operator system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Faulty operation of operator or controls.
2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

C. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering power door operators that may be incorporated into the Work include, but are not limited to, the following:

1. Electromechanical Operators for Swinging Doors-Low Profile:

a. Navig-Aider, Besam, Inc.
b. GT700, Gyrotech.
c. 4620 Series, LCN

2.2 GENERAL DOOR OPERATOR REQUIREMENTS

A. Capacity: 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.

B. Exposed Housing: Minimum 0.062-inch- thick, extruded- or formed-aluminum cover with provisions for maintenance access. Provide with fasteners concealed when door is in closed position. Finish to match doors and frames.

C. Adjustment Features: Operators shall be fully adjustable. Provide adjustment for opening, closing, and checking speeds, as well as length of time door remains open.

2.3 SWINGING DOOR OPERATORS

A. Electromechanical Operators for Swinging Doors: Manufacturer's standard electromechanical unit with doors power opened and spring closed, with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, and with easy manual operation including spring closing with power off. Provide manual shut-off switch on operator housing for securing operator. Door operator to be able to withstand cycling if activated while door is locked. Provide operator action as indicated and mounting as follows:

1. Operator Mounting Type: Surface-mounted overhead operator.
2. Power-Assisted and Low-Energy Operators: Provide power-assisted and low-energy operators meeting requirements of BHMA A156.19 and ADA's "Accessibility Guidelines for Buildings and Facilities (ADAAG)," Appendix B, Article 4.13.12, "Automatic Doors and Power-Assisted Doors."
3. Power-Assisted Closing: Provide power-assisted spring closing for overcoming wind and static pressures.

2.4 OPERATOR CONTROL SYSTEMS

A. Push-Plate Switch: Manufacturer's standard semiflush jamb mounted, door-control switch plate, including mounting boxes, for operation by touch of elbow by occupants familiar with door operating system.

1. Manufacturer’s standard nominal 4-inch square switch plate at wall mounted locations.
2. Manufacturer’s standard rectangular switch plate designed to be installed in standard aluminum storefront framing systems.
3. Switch plate material: stainless steel.
4. Provide weatherproof assemblies at exterior locations.
5. Provide PVC mounting boxes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Templates and Diagrams: Furnish templates, diagrams, and other data to fabricators and installers of related work as necessary for coordinating power door operator installation.

3.2 INSTALLATION

A. General: Install complete power door operator system according to manufacturer's written instructions, including controls, control wiring, and remote power units.

1. Refer to Division 16 Sections for power connection.

B. Set tracks, header assemblies, and operating brackets level and true to location with adequate anchorage for permanent support.

3.3 ADJUSTING

A. After repeated operation of completed installation equivalent to 3 days' use by normal traffic (100 to 300 cycles), readjust door operators and controls for optimum operating condition, safety, and weathertight closure. Lubricate hardware, operating equipment, and other moving parts.

END OF SECTION 08716

SECTION 08800 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Glazed curtain walls.
2. Glazed entrances.
3. Doors.
4. Windows.

B. Related Sections include the following:

1. Division 8 Sections “Aluminum Entrances and Storefronts” and “Glazed Aluminum Curtain Walls” for glazing gaskets, tapes, setting blocks, shims and spacers that are part of aluminum framing systems.

1.3 DEFINITIONS

A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.

B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air.

C. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

E. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

a. Specified Design Wind Loads: As indicated, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads."

b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

1) Load Duration: 60 seconds or less.

c. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

1) For insulating glass.

d. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.

e. Thickness of Tinted Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- wide interspace.
3. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq. ft. x h x deg F.
4. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
5. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- square Samples for glass.

1. Insulating glass for each designation indicated.
2. Fire-resistive glazing products.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Qualification Data: For firms and persons specified in "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.

E. Product Test Reports: From a qualified testing agency indicating the following products comply with requirements, based on comprehensive testing of current products:

1. Tinted float glass.
2. Coated float glass.
3. Insulating glass.
4. Fire-rated glazing products.

F. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

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

B. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

C. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, tinted float glass, coated float glass, laminated glass, fire-rated glass, and insulating glass.

D. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

E. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

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 "Glazing Manual".
2. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines".
3. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 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.

1.9 WARRANTY

A. General Warranty: 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. Manufacturer's Special Warranty on Coated-Glass Products: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements for those coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in schedules at the end of Part 3.

2.2 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in schedules at the end of Part 3.

2.3 HEAT-TREATED FLOAT GLASS

A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

2.4 COATED FLOAT GLASS

A. General: Provide coated glass complying with requirements indicated in this Article and in schedules at the end of Part 3.

1. Provide annealed coated float glass, except provide Kind FT (fully tempered) products where coated safety glass is indicated.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:

1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.

a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.

2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in the Insulating-Glass Schedule at the end of Part 3.

B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

C. Sealing System: Dual seal, with primary and secondary sealants as follows:

1. Manufacturer's standard sealants.

D. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.7 FIRE-RATED GLAZING PRODUCTS

A. Laminated Ceramic Glazing Material FRG-1: Category II safety glazing product in the form of 2 lites of clear ceramic glazing material laminated together to produce a laminated lite of 5/16-inch nominal thickness; polished on both surfaces; weighing 4 lb/sq. ft.; and as follows:

1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
2. Polished on both surfaces, transparent.
3. Available Products:

    a. "FireLite Plus" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.

2.8 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze 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 standard, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, 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 system.
3. Minimum required face or 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.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.

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. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

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 these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these 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 just before each glazing unit is installed.

F. 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.

3.5 PROTECTION AND CLEANING

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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended 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

build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including 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 Substantial Completion. Wash glass as recommended by glass manufacturer.

3.6 MONOLITHIC FLOAT-GLASS SCHEDULE

A. Uncoated Clear Float Glass: Where glass as designated below is indicated, provide Type I (transparent glass, flat), Class 1 (clear) glass lites complying with the following:

1. Uncoated Clear Annealed Float Glass FG-1: Annealed or Kind HS (heat strengthened), Condition A (uncoated surfaces) where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with performance requirements.
2. Uncoated Clear Fully Tempered Float Safety Glass FG-2: Kind FT (fully tempered).

3.7 LAMINATED GLASS SCHEDULE

A. Heat-Treated Laminated-Glass Units LG-1:

1. Kind LHS, consisting of two lites of heat-strengthened float glass.
2. Outer Lite: Class 1 (clear) float glass.

    a. Kind HS (heat strengthened).
    b. Thickness: 3.0 mm.

3. Inner Lite: Class 1 (clear) float glass.

    a. Kind HS (heat strengthened).
    b. Thickness: 3.0 mm.

4. Plastic Interlayer:

    a. Thickness: 0.060 inch, but not less than that required to comply as a Type II safety glass material.
    b. Interlayer Color: Clear.

3.8 INSULATING-GLASS SCHEDULE

A. Low-E Insulating Glass IG-1: Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:

1. Products: Available products include the following:

   a. Tinted Glass:

      1) Green; AFGD.
      2) Green; Guardian.
      3) Solex; PPG.

   b. Low-Emissivity Coating:

      1) Comfort E2; AFGD.
      2) LE-75; Guardian.
      3) Sungate 500; PPG.

2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
3. Interspace Content: Air.
4. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.

   a. Annealed.

5. Outdoor Lite: Type I (transparent glass, flat) float glass.

   a. Class 2 (tinted, heat absorbing, and light reducing).

      1) Tint Color: Green.

   b. Kind HS (heat strengthened), Condition A (uncoated surfaces).

6. Low-Emissivity Coating: Pyrolytic on third surface .
7. Visible Light Transmittance: .61-.64.
8. Winter Nighttime U-Value: .34-.35.
9. Summer Daytime U-Value: .37-.39.
10. Solar Heat Gain Coefficient: .44-.46.
11. Outdoor Visible Reflectance: .13-.14

B. Low-E Insulating Safety Glass IG-2: Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:

1. Products: Available products include the following:

   a. Tinted Glass:

      1) Green, AFGD.
      2) Green; Guardian.
      3) Solex, PPG.

   b. Low-Emissivity Coating:

      1) Comfort E2; AFGD.
      2) LE-17; Guardian.
      3) Sungate 500; PPG.

2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
3. Interspace Content: Air.
4. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.

    a. Kind FT (fully tempered), Condition C (other coated glass).

5. Outdoor Lite: Type I (transparent glass, flat) float glass.

    a. Class 2 (tinted, heat absorbing, and light reducing).

        1) Tint Color: Green.

    b. Kind FT (fully tempered) Condition A (uncoated surfaces).

6. Low-Emissivity Coating: Pyrolytic on third surface.
7. Visible Light Transmittance: .61-.64.
8. Winter Nighttime U-Value: .34-.35.
9. Summer Daytime U-Value: .37-.39.
10. Solar Heat Gain Coefficient: .44-.46
11. Outdoor Visible Reflectance: .13-.14.

END OF SECTION 08800

SECTION 08911 - GLAZED ALUMINUM CURTAIN WALLS

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. Glazed aluminum curtain wall, stick system installation.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 8 Section "Aluminum Entrances and Storefronts."
2. Division 8 Section "Glazing."

1.3 SYSTEM DESCRIPTION

A. General: Provide glazed aluminum curtain wall system that has the following capabilities based on testing manufacturer's standard units in assemblies similar to those indicated for this Project:

1. Withstands loads and thermal and structural movement requirements indicated without failure. Failure includes the following:

a. Air infiltration and water penetration exceeding specified limits.
b. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.

B. Glazing is physically and thermally isolated from framing members.

C. System is reglazable from the exterior.

D. Wind Loads: Provide glazed aluminum curtain wall system, including anchorage, capable of withstanding wind-loads as indicated on structural drawings.

1. Deflection of framing members in a direction normal to wall plane is limited to 1/240 plus 1/4 inch, of clear span., unless otherwise indicated.
2. Deflection of framing members overhanging an anchor point is limited to 2 times the length of the cantilevered member, divided by 175.

3. Test Performance: Provide glazed aluminum curtain wall system that does not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.

    a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
    b. Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.

E. Seismic Loads: Provide glazed aluminum curtain wall system, including anchorage, capable of withstanding the effects of earthquake motions calculated according to requirements indicated.

F. Dead Loads: Provide glazed aluminum curtain wall system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load. Provide a minimum 1/8-inch clearance between members and top of fixed panels, glazing, or other fixed part immediately below. Provide a minimum 1/16-inch clearance between members and operable windows and doors.

G. Live Loads: Provide glazed aluminum curtain wall system, including anchorage, that accommodates supporting structure's deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.

H. Air Infiltration: Provide glazed aluminum curtain wall system with permanent resistance to air leakage through system of not more than 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft..

I. Water Penetration: Provide glazed aluminum curtain wall system that does not evidence water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward acting wind-load design pressure, but not less than 10 lbf/sq. ft.

J. Thermal Movements: Provide glazed aluminum curtain wall system, including anchorage, that accommodates thermal movements of system and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, noise or vibration, and other detrimental effects.

    1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

K. Structural Support Movement: Provide glazed aluminum curtain wall system that accommodates structural movements including, but not limited to, sway, twist, column shortening, long-term creep, and deflection.

L. Condensation Resistance: Provide glazed aluminum curtain wall system with condensation-resistance factor (CRF) of not less than 55 when tested according to AAMA 1503.1.

M. Average Thermal Conductance: Provide glazed aluminum curtain wall system with an average U-value of not more than 0.66 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.1.

N. Dimensional Tolerances: Provide glazed aluminum curtain wall system, including anchorage, that accommodates dimensional tolerances of building frame and other adjacent construction.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each product specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop Drawings showing fabrication and installation of glazed aluminum curtain wall system including plans, elevations, sections, details of components, and attachments to other units of Work.

D. Product test reports from a qualified independent testing agency evidencing compliance of glazed aluminum curtain wall system with requirements based on comprehensive testing of manufacturer's current system.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

B. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing glazed aluminum curtain wall systems similar to those required for this Project and who is acceptable to manufacturer.

1. Engineering Responsibility: Prepare data for glazed aluminum curtain wall systems, including drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

C. Source Limitations: Obtain each type of glazed aluminum curtain wall system from one source and by a single manufacturer.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of a glazed aluminum curtain wall system that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including, but not limited to, excessive deflection.
2. Noise or vibration caused by thermal movements.
3. Failure of system to meet performance requirements.
4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
5. Failure of operating components to function normally.
6. Water leakage.
7. Glazing breakage.

C. Warranty Period: 1 year from date of Substantial Completion.

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:

1. Butler Manufacturing Company; Vistawall Architectural Products.
2. EFCO Corporation.
3. Kawneer Company, Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.

B. Glazing as specified in Division 8 Section "Glazing."

C. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers; in hardness recommended by manufacturer.

D. Framing system gaskets and joint fillers as recommended by manufacturer for joint type.

E. Sealants and joint fillers for joints within glazed aluminum curtain wall system as specified in Division 7 Section "Joint Sealants."

F. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.

2.3 COMPONENTS

A. Brackets and Reinforcements: Provide manufacturer's standard high-strength aluminum brackets and reinforcements. Provide nonstaining, nonferrous shims for aligning system components.

B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Finish exposed portions to match glazed aluminum curtain wall.

1. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.
2. Where fasteners anchor into aluminum less than 0.125 inch thick, provide reinforcement to receive fastener threads.

C. Anchors: 3-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing, compatible with adjacent materials, and of type recommended by manufacturer.

2.4 FABRICATION

A. General: Fabricate glazed aluminum curtain wall system according to Shop Drawings. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After

fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

C. Prepare components to receive concealed fasteners and anchor and connection devices.

D. Fabricate components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.

E. Glazing Pockets: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."

F. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

2.5 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of glazed aluminum curtain wall system. Do not proceed with installation until unsatisfactory conditions have been corrected or accommodations acceptable to Architect have been made.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing glazed aluminum curtain wall system. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight, unless otherwise indicated. Provide means to drain water to the exterior to produce a permanently weatherproof system.

B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.

D. Install framing members plumb and true in alignment with established lines and grades.

E. Anchorage: After system components are positioned, fix connections to building structure as indicated on Shop Drawings.

1. Provide separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Install glazing according to Shop Drawings. Comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.

G. Install sealant according to Shop Drawings. Comply with requirements of Division 7 Section "Joint Sealants," unless otherwise indicated.

H. Erection Tolerances: Install glazed aluminum curtain wall system to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment: Where surfaces abut in line, limit offset from true alignment to 1/16 inch; where a reveal or protruding element separates aligned surfaces by less than 2 inches, limit offset to 1/2 inch.
4. Location: Limit variation from plane or location shown on Shop Drawings to 1/8 inch in 12 feet; 1/2 inch over total length.

3.3 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure glazed aluminum curtain wall system is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08911

SECTION 09253 - GYPSUM SHEATHING

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 gypsum sheathing attached to steel framing members of exterior walls.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for masonry-veneer anchors.
2. Division 5 Section "Cold-Formed Metal Framing" for steel framing supporting gypsum sheathing.
3. Division 9 Section "Gypsum Board Assemblies" for steel-framed assemblies with wallboard on the interior.

1.3 DEFINITIONS

A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. Product Data: For each type of product specified.

1. For proprietary building-wrap air-infiltration barrier, include data substantiating compliance with building code in effect for Project.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each gypsum sheathing product through one source from a single manufacturer.

B. Fire-Resistance-Rated Assemblies: Where gypsum sheathing boards are part of fire-resistance-rated assemblies, provide assemblies as follows:

1. Assemblies comply with requirements of fire-response-tested assemblies indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual"; or by design designations in UL's "Fire Resistance Directory" or in certification listings of another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Fire-resistance ratings were determined by fire-response testing assemblies according to ASTM E 119.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles, each bearing brand name and identification of manufacturer.

B. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Neatly stack gypsum sheathing board flat on leveled supports off the ground, under cover, and fully protected from weather.

1.7 SEQUENCING AND SCHEDULING

A. Sequence installing sheathing with installing exterior cladding to comply with requirements indicated below:

1. Do not leave paper-surfaced gypsum sheathing board exposed to weather for more than 30 days or for more than 180 days if protected as indicated in Part 3 "Protection" Article.

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:

1. Paper-Surfaced Gypsum Sheathing Board:

a. Georgia-Pacific Corp.
b. National Gypsum Co.; Gold Bond Building Products Division.
c. USG Corp.; United States Gypsum Co.

2.2 GYPSUM SHEATHING BOARD

A. Paper-Surfaced Gypsum Sheathing Board with Water-Resistant Core: ASTM C 79, with water-resistant material incorporated into the core and with water-repellent paper bonded to the core's face, back, and long edges.

1. Type and Thickness: Type X, 5/8 inch thick.
2. Edge and End Configuration: Square.
3. Size: 48 by 96 inches.

2.3 ACCESSORY MATERIALS

A. Air-Infiltration Barrier: Proprietary building wrap with flame-spread and smoke-developed ratings of less than 25 and 450, respectively, when tested according to ASTM E 84. Provide one of the following products:

1. Polyethylene sheet; 0.0038 to 0.0064 inch thick; formed by spinning continuous strands of fine, high-density-polyethylene interconnected fibers and bonding them together by heat and pressure; incorporating an additive to provide ultraviolet light resistance for up to 120 days; and with a water-vapor transmission rate equaling 535 g through 1 sq. m of surface in 24 hours according to ASTM E 96, Desiccant Method (Method A).

   a. Product: Subject to compliance with requirements, provide "Tyvek Housewrap" by DuPont Company.

2. Polypropylene sheet; 0.0115 inch thick; consisting of spun-bonded polypropylene substrate with a polypropylene coating attached directly to one side; and with a water-vapor transmission rate equaling 125 g through 1 sq. m of surface in 24 hours according to ASTM E 96, Desiccant Method (Method A).

   a. Product: Subject to compliance with requirements, provide "Typar HouseWrap" by Reemay, Inc.

3. Laminated polyethylene sheet; 0.003 inch thick; consisting of 2 plies of microperforated, cross-laminated, high-density polyethylene sheet; and with a water-vapor transmission rate equaling 125 g through 1 sq. m of surface in 24 hours according to ASTM E 96, Desiccant Method (Method A).

   a. Product: Subject to compliance with requirements, provide "Rufco-Wrap" by Raven Industries, Inc.

4. Woven polyolefin sheet; 0.005 inch thick; with a water-vapor transmission rate equaling 63 g through 1 sq. m of surface in 24 hours according to ASTM E 96, Desiccant Method (Method A).

   a. Product: Subject to compliance with requirements, provide "Barricade Building Wrap" by Anthony Industries, Simplex Products Division.

B. Fasteners: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117, and as follows:

1. Provide steel drill screws complying with ASTM C 1002 to attach sheathing to steel framing less than 0.0329 inch thick.
2. Provide steel drill screws complying with ASTM C 954 to attach sheathing to steel framing from 0.033 to 0.112 inch thick.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Install gypsum sheathing to comply with GA-253 and manufacturer's written instructions.

B. Cut boards at penetrations, edges, and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8-inch setback where non-load-bearing construction abuts structural elements.

C. Coordinate sheathing installation with flashing so these materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.

D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.

E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.

F. Installation: Install 48-inch- wide gypsum sheathing boards with edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud as follows:

1. Fasteners spaced approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

G. Air-Infiltration Barrier Application: Cover sheathing with air-infiltration barrier as follows:

1. Cut back air-infiltration barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply proprietary building wrap to comply with manufacturer's written installation instructions.

3. Apply air-infiltration barrier to cover vertical flashing with a 4-inch overlap.

3.2 PROTECTION

A. Protect paper-surfaced gypsum sheathing that will be exposed to weather for more than 30 days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier. Apply covering immediately after sheathing is installed.

END OF SECTION 09253

SECTION 09260 - GYPSUM BOARD ASSEMBLIES

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. Interior gypsum wallboard.
2. Tile backing panels.
3. Non-load-bearing steel framing.

B. Related Sections include the following:

1. Division 5 Section "Cold-Formed Metal Framing " for load-bearing steel framing.
2. Division 7 Section "Building Insulation" for insulation and vapor retarders installed in gypsum board assemblies.
3. Division 9 Section "Gypsum Sheathing " for installations over steel framing.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum 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.

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:

1. Steel Framing and Furring:

a. Clark Steel Framing Systems.
b. Dale Industries, Inc. - Dale/Incor.
c. Unimast, Inc.

2. Gypsum Board and Related Products:

a. G-P Gypsum Corp.
b. National Gypsum Company.
c. United States Gypsum Co.

2.2 STEEL SUSPENDED CEILING FRAMING

A. Components, General: Comply with ASTM C 754 for conditions indicated.

B. Hanger Attachments to Concrete: As follows:

1. 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 a qualified independent testing agency.

C. Hangers: As follows:

1. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.

D. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

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

a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
b. Chicago Metallic Corporation; Drywall Furring 640 System.
c. USG Interiors, Inc.; Drywall Suspension System.

2.3 STEEL PARTITION FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: As indicated.
2. Depth: As indicated.

C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- deep flanges.

D. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.4 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Gypsum Wallboard: ASTM C 36.

1. Type X:

a. Thickness: 5/8 inch.
b. Long Edges: Tapered.

2.5 TILE BACKING PANELS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Cementitious Backer Units: ANSI A118.9.

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

a. Custom Building Products; Wonderboard.
b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
c. United States Gypsum Co.; DUROCK Cement Board.

2. Thickness: 5/8 inch.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead: Use at outside corners.
b. LC-Bead (J-Bead): Use at exposed panel edges.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

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. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
2. Fill Coat: For second coat, use drying-type, all-purpose compound.
3. Finish Coat: For third coat, use drying-type, all-purpose compound.
4. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by manufacturer.

2.8 ACOUSTICAL SEALANT

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

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 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.

2.9 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. 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.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Thickness: 3 inches minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

    a. Use deep-leg deflection track where indicated.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.3 INSTALLING STEEL SUSPENDED CEILING FRAMING

A. Suspend ceiling 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 ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck. Attach hangers to structural members.
5. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.

C. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the manufacturer's framing and installation standards.

1. Hangers: 48 inches o.c.
2. Main Beams: 48 inches o.c.
3. Cross-Furring: 24 inches o.c.

D. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.4 INSTALLING STEEL PARTITION FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch short of full height to provide perimeter relief.

D. Install steel studs and furring at the following spacings:

1. Single-Layer Construction: 24 inches o.c., unless otherwise indicated.
2. Cementitious Backer Units: 16 inches o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. 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.

1. Install two studs at each jamb, unless otherwise indicated.
2. 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.
3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. 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.

3.5 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum 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.

E. 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.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.).

1. Fit gypsum panels around ducts, pipes, and conduits.
2. 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.

I. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches o.c. for vertical applications.

J. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.6 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of board.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Tile Backing Panels:

1. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

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.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

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. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

C. 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.
2. 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 at painted walls.

END OF SECTION 09260

SECTION 09310 - CERAMIC TILE

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. Ceramic mosaic tile.
2. Glazed wall tile.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Division 9 Section "Gypsum Board Assemblies" for cementitious backer units installed in gypsum wallboard assemblies.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.

1.5 SUBMITTALS

A. Product Data: For each type of tile, mortar, grout, and other products specified.

B. Tile Samples for Initial Selection: Manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include Samples of accessories involving color selection.

C. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

D. 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 of architects and owners, and other information specified.

E. Setting Material Test Reports: Indicate and interpret test results for compliance of tile-setting and grouting products with specified requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

1.7 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 coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.9 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

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:

1. Tile Products:

a. American Olean Tile Company.
b. Dal-Tile Corporation.
c. Florida Tile Industries, Inc.

2. Tile-Setting and -Grouting Materials:

a. Dal-Tile Corporation.
b. Laticrete International, Inc.
c. Mapei Corporation.

3. Grout Sealers:

a. Aquamix, Inc.
b. Custom Building Products/Tile Lab.
c. Hillyard Floor Treatments

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

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 Architect's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.
2. Provide tile trim and accessories that match color and finish of adjoining flat tile.

D. Factory Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved Samples.

E. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

2.3 TILE PRODUCTS

A. Unglazed Ceramic Mosaic Tile: Provide factory-mounted flat tile complying with the following requirements:

1. Composition: Porcelain.
2. Module Size: 2 by 2 inches.
3. Nominal Thickness: 1/4 inch.
4. Face: Plain with cushion edges.
5. Mounting: Factory back-mounted.
6. Price Group: 2.

B. Glazed Wall Tile: Provide flat tile complying with the following requirements:

1. Module Size: 4-1/4 by 4-1/4 inches.
2. Thickness: 5/16 inch.
3. Face: Plain with modified square edges or cushion edges.
4. Price Group: 2

C. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the 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 Thin-Set Mortar Installations: Straight.
    b. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.
    c. External Corners for Thin-Set Mortar Installations: Surface bullnose.
    d. Internal Corners: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar: ANSI A118.4, composed as follows:

1. Prepackaged Dry-Mortar Mix: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to which only water needs to be added at Project site.

2.5 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI A118.6 for materials described in Section H-2.4, composed as follows:

1. Factory-Prepared, Dry-Grout Mixture: Factory-prepared mixture of portland cement; dry, redispersible, ethylene vinyl acetate additive; and other ingredients to produce the following:

    a. Unsanded grout mixture for joints less than 1/8 inch.
    b. Sanded grout mixture for joints 1/8 inch and wider.

2.6 WATERPROOF CRACK-SUPPRESSION MEMBRANE FOR THIN-SET TILE INSTALLATIONS

A. General: Manufacturer's standard product that complies with ANSI A118.10.

B. Chlorinated-Polyethylene-Sheet Product: Nonplasticized, chlorinated polyethylene faced on both sides with high-strength, nonwoven polyester fabric, for adhering to latex-portland cement mortar; 60 inches (1524 mm) wide by 0.030-inch (0.76-mm) nominal thickness.

    a. Available Product: Noble Company (The); Nobleseal TS.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

C. Grout Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions 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; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
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.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a

terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Blending: For tile exhibiting color variations within the ranges selected during Sample submittals, verify that tile has been blended in the factory and packaged so 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.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. 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 plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the 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 indicated.

1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Lay out tile wainscots to next full tile beyond dimensions indicated.

G. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.

H. Grout tile to comply with the requirements of the following tile installation standards:

1. For ceramic tile grouts, comply with ANSI A108.10.

3.4 WATERPROOF CRACK-SUPPRESSION MEMBRANE INSTALLATION

A. Install waterproof crack-suppression membrane to comply with manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.

3.5 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.

B. Joint Widths: Install tile on floors with the following joint widths:

1. Ceramic Mosaic Tile: 1/8 inch.

3.6 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:

1. Wall Tile: 1/16 inch.

3.7 CLEANING, SEALING, AND PROTECTING

A. Cleaning: On 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 written instructions, but no sooner than 10 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.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout

joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

1. When recommended by tile manufacturer, apply a 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.

E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.8 CERAMIC TILE FLOOR INSTALLATION SCHEDULE

A. Ceramic Tile Floor Installation: Where interior floor installations are indicated, comply with the following:

1. Tile Type/Products: Unglazed ceramic mosaic tile. Available products include the following:

   a. Unglazed Ceramic Mosaics; American Olean.
   b. Keystones; Daltile.
   c. Unglazed Ceramic Mosaics; Florida Tile.

2. Installation Method: TCA F122 (waterproof crack-suppression membrane over concrete; thinset mortar).
3. Mortar and Grout: ANSI A108.5 with the following mortar and grout:

   a. Latex-portland cement mortar.
   b. Sanded latex-portland cement grout.

3.9 CERAMIC TILE WALL INSTALLATION SCHEDULE

A. Ceramic Tile Wall Installations: Where interior wall installations are indicated, comply with the following:

1. Tile Type/Products: Glazed wall tile. Available products include the following:

   a. Bright; American Olean.
   b. Semigloss; Daltile.
   c. Bright; Florida Tile.

2. Installation Method: TCA W244 (thin-set mortar bonded to cementitious backer units on metal studs).
3. Setting Bed and Grout: ANSI A108.5 with the following mortar and grout:

    a. Latex-portland cement mortar.
    b. Unsanded latex-portland cement grout.

END OF SECTION 09310

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

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 ceilings consisting of acoustical panels and exposed suspension systems.

1.3 SUBMITTALS

A. Product Data: For each type of product specified.

B. Samples for Initial Selection: Manufacturer's color charts consisting of actual acoustical panels or sections of acoustical panels, suspension systems, and moldings showing the full range of colors, textures, and patterns available for each type of ceiling assembly indicated.

C. Qualification Data: For firms and persons specified in "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.

D. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.

E. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
3. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, 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.

1.6 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.

1.7 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.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

C. Panel Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3, including those referencing ASTM E 1264 classifications.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Metal Suspension System Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3.

C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

D. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.

1. Postinstalled Powder-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.

E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three 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-inch- diameter (12 gauge) wire.

F. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. Provide minimum 2 inch deep perimeter edge molding.

2.4 ACOUSTICAL SEALANT

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:

1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

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

1. Acoustical Sealant for Exposed and Concealed Joints:

a. PL Acoustical Sealant; Chemrex, Inc., Contech Brands.
b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
c. SHEETROCK Acoustical Sealant; United States Gypsum Co.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and 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 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. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
2. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4."
3. 2000 IBC Section 1621.2.5, “Suspended Ceilings”.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. At splayed wires, offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. 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.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
2. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

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.

3.5 ACOUSTICAL PANEL CEILING SCHEDULE

A. Water-Felted, Mineral-Base Acoustical Panels for Acoustical Panel Ceiling: Where indicated, provide acoustical panels complying with the following:

1. Products: Available products include the following:

a. Cortega; Armstrong.
b. Baroque; Celotex.
c. Radar; USG Interiors.

2. Classification: Panels fitting ASTM E 1264 for Type III, mineral base with painted finish; Form 2, water felted.

3. Pattern: Panels fitting ASTM E 1264 pattern designation (description) C (perforated, small holes). D (fissured).
4. Color: White.
5. Light Reflectance Coefficient: Not less than LR 0.80.
6. Noise Reduction Coefficient: Not less than NRC 0.55.
7. Ceiling Attenuation Class: Not less than 25.
8. Edge Detail: Square edge.
9. Thickness: 5/8 inch.
10. Size: 24 by 48 inch.

B. Suspension System for Acoustical Panel Ceilings: Where indicated, provide acoustical panel ceiling suspension system complying with the following:

1. Products: Available products include the following:

   a. Prelude XL 15/16” Exposed Tee System; Armstrong.
   b. 1200 System; Chicago Metallic.
   c. DX26; USG Interiors.

2. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G01 coating designation, with prefinished 15/16 inch- wide metal caps on flanges; other characteristics as follows:

   a. Structural Classification: Heavy-duty system.
   b. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
   c. Face Design: Flush face.
   d. Cap Material: Steel sheet.
   e. Cap Finish: Painted white.

END OF SECTION 09511

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

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. Resilient wall base.

1.3 SUBMITTALS

A. Product Data: For each type of product specified.

B. Samples for Initial Selection: Manufacturer's standard sample sets consisting of sections of units showing the full range of colors and patterns available for each type of product indicated.

C. Product Certificates: Signed by manufacturers of resilient wall base and accessories certifying that each product furnished complies with requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain each type and color of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg. F.

C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.6 PROJECT CONDITIONS

A. Maintain a temperature of not less than 70 or more than 95 deg. F in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 deg. C or more than 95 deg. C.

B. Do not install products until they are at the same temperature as the space where they are to be installed.

C. Coordinate resilient product installation with other construction to minimize possibility of damage and soiling during remainder of construction period. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof, of each different type, color, pattern, and size of resilient product installed.
2. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Resilient Wall Base and Accessory Schedule at the end of Part 3.

2.2 RESILIENT WALL BASE

A. Rubber Wall Base: Products complying with FS SS-W-40, Type I and with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.3 RESILIENT ACCESSORIES

A. Rubber Accessories: Products complying with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.4 INSTALLATION ACCESSORIES

A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements, including those for maximum moisture content. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

B. Remove coatings, including curing compounds, 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.

C. Broom and vacuum clean substrates to be covered immediately before installing resilient products. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. General: Install resilient products according to manufacturer's written installation instructions.

B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
3. Do not stretch base during installation.
4. Form outside corners on job, from straight pieces of maximum lengths possible, without whitening at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
5. Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

C. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
2. Sweep or vacuum horizontal surfaces thoroughly.
3. Do not wash resilient products until after time period recommended by resilient product manufacturer.
4. Damp-mop or sponge resilient products to remove marks and soil.

B. Protect resilient products against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by resilient product manufacturer.

C. Clean resilient products not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

3.5 RESILIENT WALL BASE AND ACCESSORY SCHEDULE

A. Rubber Wall Base: Where indicated, provide rubber wall base complying with the following:

1. Available Manufacturers: As follows:

a. Burke
b. Flexco

c. Roppe

2. Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for rubber wall base complying with requirements indicated.
3. Style: Cove with top-set toe at resilient flooring. Straight with no toe at carpet.
4. Minimum Thickness: 1/8 inch.
5. Height: 4 inches.
6. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet.
7. Outside Corners: Job formed.
8. Inside Corners: Job formed.
9. Ends: Premolded.
10. Surface: Smooth.

END OF SECTION 09653

SECTION 09680 -CARPET (STATE CARPET CONTRACT)

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. Tufted carpet.

B. Related Sections include the following:

1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate required.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of subfloor.
6. Type of installation.
7. Pattern type, repeat size, location, direction, and starting point.
8. Pile direction.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet: 12-inch-square Sample.

2. Exposed Edge Stripping and Accessory: 12-inch-long Samples.
3. Carpet Seam: 6-inch Sample.

D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.

E. Maintenance Data: For carpet to include in maintenance manuals specified in Division 1. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.4 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

1.6 WARRANTY

A. Carpet Warranty: As included in State Carpet Contract.

PART 2 - PRODUCTS

2.1 CARPET

A. Product: Subject to compliance with requirements, provide the following:

1. Arches; Designweave; Shaw Industries. State of Utah Contract # PD-392.

a. Source: Midwest Office.

1) Address: 987 South West Temple, Salt Lake City, Utah.
2) Phone Number: (801) 359-7681.
3) Contact: William Cluff.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the following:

1. Carpet manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the following:

1. Carpet manufacturer.

C. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the following:

a. Carpet manufacturer.

2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by the following:

1. Carpet manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Direct-Glue-Down Installation: Comply with CRI 104, Section 8, "Direct Glue-Down Installation."

B. Comply with carpet manufacturer's written recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

D. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

F. Install pattern parallel to walls.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 15, "Protection of Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 09680

SECTION 09912 - PAINTING

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 surface preparation and field painting of exposed interior items and surfaces.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

1. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application.

Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of finish-coat material indicated.

1. After color selection, Architect will furnish color chips for surfaces to be coated.

C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:

a. Acrylic Enamel: 2 gal. of each color and gloss applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Kelly-Moore Paint Co. (Kelly-Moore).
2. Kwal-Howells Paint (Kwal Paint)
3. Sherwin-Williams Co. (Sherwin-Williams).
4. Or equal.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

2.3 INTERIOR PRIMERS

A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.

1. Kelly-Moore; 971 Acry-Prime Interior Latex Primer/Sealer: Applied at a dry film thickness of not less than 1.6 mils.
2. Kwal Paint; 0880 Latex Sealer: Applied at a dry film thickness of not less than 1.5 mils.
3. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils.

B. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive acrylic-based metal primer.

1. Kelly-Moore; 1725 Kel-Guard Acrylic Metal Primer: Applied at a dry film thickness of not less than 1.6 mils.
2. Kwal Paint; 5860 100 Percent Acrylic All-Purpose Primer: Applied at a dry film thickness of not less than 1.5 mils.
3. Sherwin-Williams; Pro-Cryl Universal Primer B66310: Applied at a dry film thickness of not less than 3 mils.

2.4 INTERIOR FINISH COATS

A. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.

1. Kelly-Moore; 1649 Acrylic-Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.7 mils.
2. Kwal Paint; 2300 Accu-Tone Interior Latex Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.5 mils.
3. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates, or substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Dull surfaces with glossy, glazed or dense finishes.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying 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. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
2. Provide finish coats that are compatible with primers used.

3. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
5. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
7. Sand lightly between each succeeding enamel or varnish coat.

B. 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. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical items to be painted include, but are not limited to, the following:

1. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.

F. Electrical items to be painted include, but are not limited to, the following:

1. Panelboards.

G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior gypsum board primer.
b. Finish Coats: Interior semigloss acrylic enamel.

B. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior ferrous-metal primer.
b. Finish Coats: Interior semigloss acrylic enamel.

END OF SECTION 09912

SECTION 10101 - VISUAL DISPLAY BOARDS

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. Porcelain enamel markerboards.

1.3 SUBMITTALS

A. Product Data: For each type of visual display board indicated.

B. Shop Drawings: For each type of visual display board required.

1. Include dimensioned elevations. Show location of joints between individual panels where unit dimensions exceed maximum panel length.
2. Include sections of typical trim members.
3. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available for the following:

1. Markerboards: Actual sections of porcelain enamel finish

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain visual display boards through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify field measurements before preparation of Shop Drawings and before fabrication to ensure proper fitting. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.6 WARRANTY

A. General Warranty: The special porcelain enamel markerboard warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Porcelain Enamel Markerboard Warranty: Submit a written warranty executed by manufacturer agreeing to replace porcelain enamel markerboards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking within the specified warranty period, provided the manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.

1. Warranty Period: 50 years from date of Substantial Completion.

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:

1. Porcelain Enamel Markerboards:

a. Claridge Products and Equipment, Inc.
b. Greensteel, Inc.
c. Lemco, Inc.

2.2 MATERIALS

A. Porcelain Enamel Markerboards: Balanced, high-pressure-laminated, porcelain enamel markerboards of 3-ply construction consisting of face sheet, core material, and backing.

1. Face Sheet: 0.024-inch enameling grade steel especially processed for temperatures used in coating porcelain on steel. Coat exposed face and edges with a 3-coat process consisting of primer, ground coat, and color cover coat. Coat concealed face with a 2-coat process consisting of primer and ground coat. Fuse

cover and ground coats to steel at manufacturer's standard firing temperatures, but not less than 1200 deg F.

a. Cover Coat: Provide manufacturer's standard, light-colored, special writing surface with gloss finish intended for use with erasable dry markers.

2. Core: 3/8-inch- thick, particleboard core material complying with requirements of ANSI A208.1, Grade 1-M-1.
3. Backing Sheet: 0.015-inch- thick, aluminum-sheet backing.
4. Laminating Adhesive: Manufacturer's standard, moisture-resistant, thermoplastic-type adhesive.

2.3 ACCESSORIES

A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick, extruded-aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure.

1. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
2. Markertray: Manufacturer's standard, continuous, solid, extrusion-type, aluminum markertray with ribbed section and smoothly curved exposed ends for each markerboard.
3. Map Rail: Furnish map rail at top of each unit, complete with the following accessories:

a. Display Rail: Provide continuous cork display rail approximately 1 inch wide, integral with map rail.
b. End Stops: Provide one end stop at each end of map rail.
c. Map Hooks: Provide 2 map hooks for every 48 inches of map rail or fraction thereof.

2.4 FABRICATION

A. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.

2.5 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation of visual display boards.

1. Surfaces to receive markerboards shall be free of dirt, scaling paint, and projections or depressions that would affect smooth, finished surfaces of markerboards.
2. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Deliver factory-built visual display boards completely assembled in one piece without joints, where possible. If dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints to maintain surface alignment.

B. Install units in locations and at mounting heights indicated and according to manufacturer's written instructions. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

C. Coordinate Project-site-assembled units with grounds, trim, and accessories. Join parts with a neat, precision fit.

3.3 ADJUSTING AND CLEANING

A. Verify that accessories required for each unit have been properly installed and that operating units function properly.

B. Clean units according to manufacturer's written instructions.

END OF SECTION 10101

SECTION 10155 - TOILET COMPARTMENTS

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 toilet compartments and screens as follows:

1. Type: Steel, color-coated finish.
2. Compartment Style: Overhead braced and floor anchored.
3. Screen Style: Wall hung.

B. Related Sections include the following:

1. Division 10 "Toilet and Bath Accessories" for grab bars, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware, and fastenings.

B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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:

1. Crane Plumbing; Sanymetal.
2. Flush Metal Partition.
3. Knickerbocker Partition Corporation.

2.2 MATERIALS

A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are unacceptable.

B. Steel Sheets for Color-Coated Finish: Provide mill-phosphatized steel sheet that is leveled to stretcher-leveled flatness complying with the requirements of standards indicated below:

1. Electrolytically Zinc-Coated Steel Sheet: ASTM A 591, Class C, of the following minimum thicknesses:

a. Pilasters (Overhead Braced): 0.0359 inch.
b. Panels and Screens: 0.0359 inch.
c. Doors: 0.0299 inch.

C. Core Material for Metal-Faced Units: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch minimum for doors, panels, and screens and 1-1/4 inches minimum for pilasters.

D. Pilaster Shoes and Sleeves (Caps): ASTM A 666, Type 302 or 304 stainless steel, not less than 0.0312 inch thick and 3 inches high, finished to match hardware.

E. Stirrup Brackets: Manufacturer's standard ear or U-brackets for attaching panels and screens to walls and pilasters of the following material:

1. Material: Chrome-plated, nonferrous, cast zinc alloy (zamac) or clear-anodized aluminum.

F. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of the following material:

1. Material: Chrome-plated, nonferrous, cast zinc alloy (zamac) or clear-anodized aluminum.

G. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile in manufacturer's standard finish.

H. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.

1. Provide internal reinforcement in metal units for compartment-mounted hardware, accessories, and grab bars, as indicated.

B. Metal-Faced Toilet Compartments and Screens: Pressure laminate seamless face sheets to core material and provide continuous, interlocking molding strip or lapped and formed edges. Seal corners by welding or clips. Grind exposed welds smooth.

C. Overhead-Braced-and-Floor-Anchored Compartments: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.

D. Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as compartment panels, unless otherwise indicated.

1. Provide metal-faced screens with integral full-height flanges for attachment to wall.

E. Doors: Unless otherwise indicated, provide 24-inch- wide in-swinging doors for standard toilet compartments and 36-inch- wide out-swinging doors with a minimum 32-inch- wide clear opening for compartments indicated to be handicapped accessible.

1. Hinges: Manufacturer's standard self-closing type that can be adjusted to hold door open at any angle up to 90 degrees.
2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
4. Door Bumper: Manufacturer's standard rubber-tipped bumpers at out-swinging doors or entrance screen doors.

5. Door Pull: Manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

2.4 ZINC- OR ZINC-ALLOY-COATED STEEL SHEET FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying finishes.

B. Color-Coated Finish: Provide manufacturer's standard baked finish complying with coating manufacturer's written instructions for pretreatment, application, baking, and minimum dry film thickness.

1. Color: One color in each room as selected by Architect from manufacturer's full range of colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, plumb, and level. Provide clearances of not more than 1/2 inch between pilasters and panels and not more than 1 inch between panels and walls. Secure units in position with manufacturer's recommended anchoring devices.

1. Secure panels to walls and panels with not less than 2 stirrup brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced-and-Floor-Anchored Compartments: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than 2 fasteners. Hang doors and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING AND CLEANING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return to fully closed position.

B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10155

SECTION 10410 - FREESTANDING SIGNS

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. Nonilluminated freestanding signs.

B. Related Sections include the following:

1. Division 10 Section "Signs" for interior wall mounted signs..

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes freestanding signs.

B. Shop Drawings: Include plans, elevations, sections, details.

C. Samples for Initial Selection: Manufacturer’s color charts indicating full range of available colors.

D. Warranty: Special warranty specified in this Section.

E. Other Action Submittals: As follows:

1. Message-Strip Schedule: Layout of each message strip showing letter size, font, spacing, indents, and copy.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain freestanding signs through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of freestanding signs and are based on the specific system indicated. Refer to Division 1 Section "Product 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.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of freestanding signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures of frames.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: ASTM B 209M.
2. Extruded Shapes: ASTM B 221M, Alloy 6063.

B. ABS Sheet: Manufacturer’s standard.

C. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.

2.3 FREESTANDING SIGNS

A. Nonilluminated, Freestanding Sign: Factory-fabricated unit consisting of changeable message strips held in place by retainer frame enclosed in manufacturer's standard perimeter frame; with rear cover panel:

1. Available Manufacturers:

   a. System 2/90.
   b. Or equal.

2. Freestanding Sign System: Manufacturer’s standard system including rails, retainer frame, message strips, backing panel, header panel, and foot glides.

   a. Perimeter Frame: Extruded aluminum.
   b. Perimeter Frame Profile: Square.
   c. Backing Panel: ABS.
   d. Perimeter Frame Corners: Square.
   e. Header and Spacer Panels: Provide copy that complies with requirements indicated on Drawings for size, style, spacing, content, height, location, material, and colors of graphics.
   f. Accent Strips: Extruded aluminum.

      1) Color: As selected by Architect from full range of industry colors and color densities.

3. Aluminum Finish: Provide baked enamel at accent strips. Provide clear brushed finish at frame, header, and spacer panels.

   a. Color: As selected by Architect from full range of industry colors and color densities.

4. Applied-Copy Changeable Message Strips: Screen-printed copy applied to ABS message-strips.

   a. Message-Strip and Letter Colors: As selected by Architect from full range of industry colors and color densities.

5. Width: As indicated on Drawings.
6. Height: As indicated on Drawings.

2.4 FABRICATION

A. Fabricate freestanding signs to requirements indicated for dimensions, design, and thickness and finish of materials. Use metals and shapes of thickness and reinforcing to produce flat surfaces, free of oil canning, and to impart strength for size, design, and application indicated.

B. Message-Strip Signs: Provide message strips with wording and other designations for the locations where wording is indicated. Include blank message strips as needed to fill out remainder of sign.

C. Provide adjustable foot glides for freestanding signs.

2.5 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.

2.6 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 0.04 mm, medium gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install freestanding signs in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

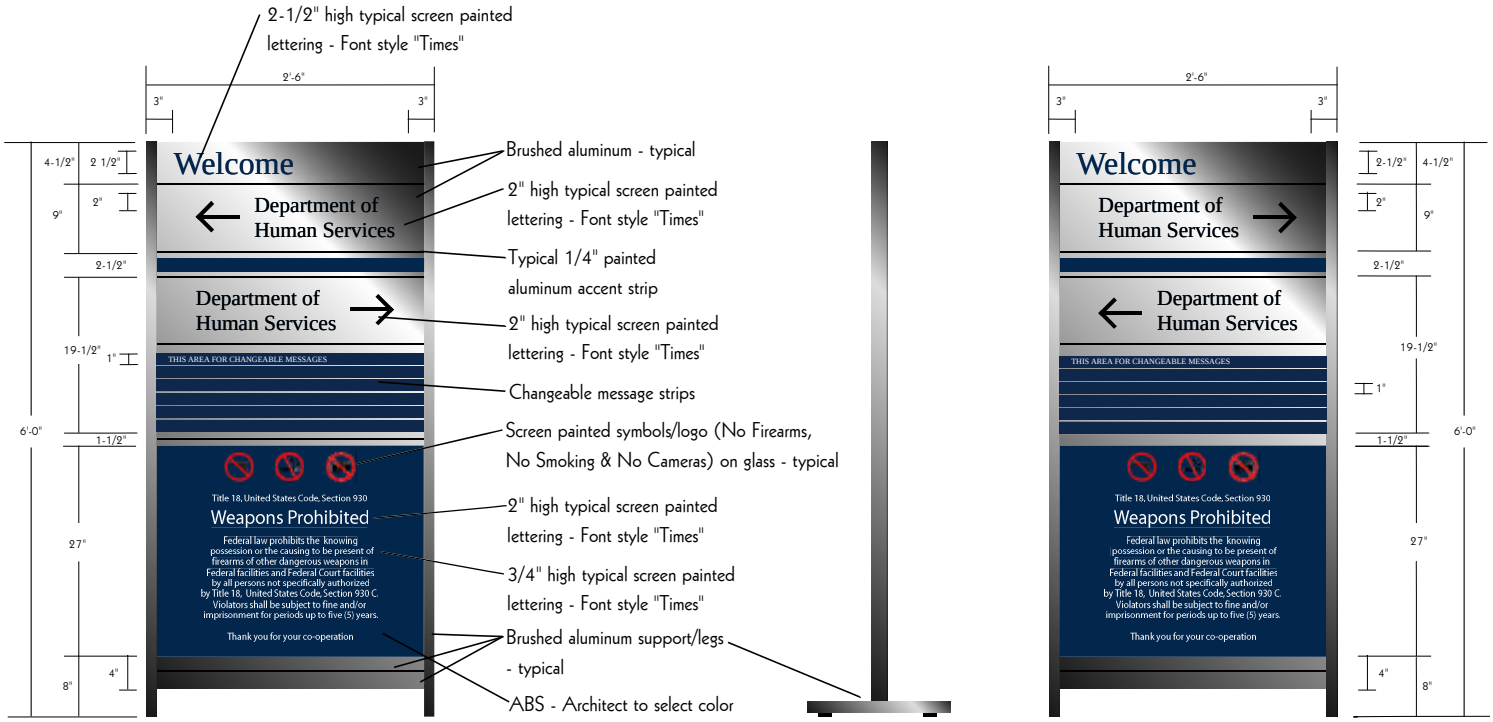
B. Freestanding Signs: Install freestanding signs in locations indicated. Adjust floor glides so signs are level and plumb.

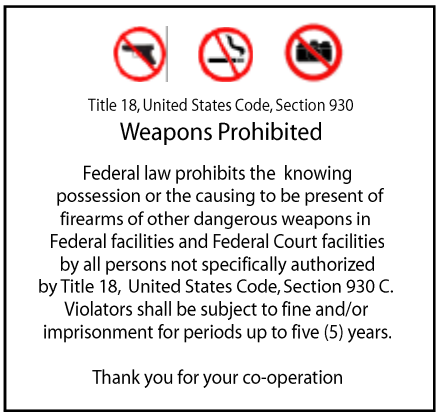
3.3 ADJUSTING AND CLEANING

A. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 10410

Sign Type: Freestanding Welcome Sign





DWS - DHS CONNECTOR FREESTANDING SIGN

SECTION 10431 - SIGNS

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 types of signs:

1. Panel signs.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.

1. Provide message list for each sign required, including large-scale details of wording and lettering layout.

D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.

1. Samples for initial selection of color, pattern, and texture:

a. Cast Acrylic Sheet: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

1.4 QUALITY ASSURANCE

A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and

sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Manufacturers of Panel Signs:

a. ASI Sign Systems, Inc.
b. Seton Identification Products
c. The Supersine Company.

2.2 MATERIALS

A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F (80 deg C), and of the following general types:

1. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.

B. ABS Plastic: Provide high-impact thermoplastic composed of copolymers of acrylonitrile, butadiene, and styrene.

2.3 PANEL SIGNS

A. Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, designs, shapes, sizes, and details of construction.

B. Framed Panel Signs: Fabricate frames to profile indicated; comply with the following requirements for materials and corner conditions:

1. Material: Injection molded ABS plastic.
2. Corner Condition: Square corners.

C. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, and finishes of letters, numbers, and other graphic devices.

D. Raised Copy: Machine-cut copy characters from matte-finished opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.

1. Panel Material: Matte-finished opaque acrylic sheet.
2. Raised Copy Thickness: Not less than 1/32 inch.

E. Braille: Raised tactile Grade 2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

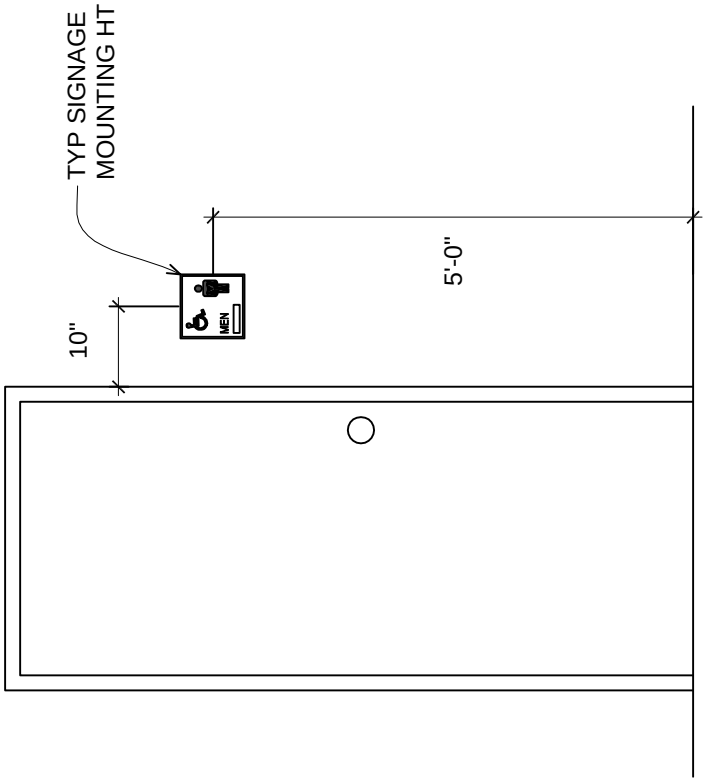
B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:

1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

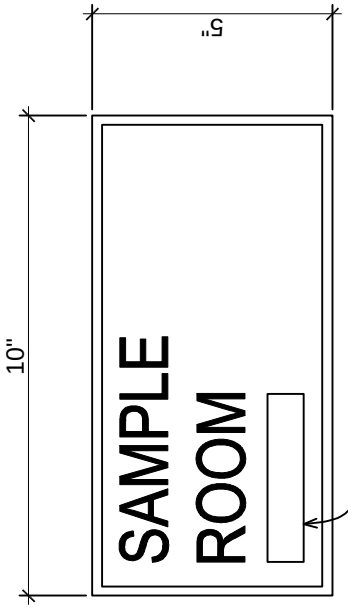
3.2 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 10431



MOUNTING HEIGHT DETAIL
SCALE = 1/2"=1"



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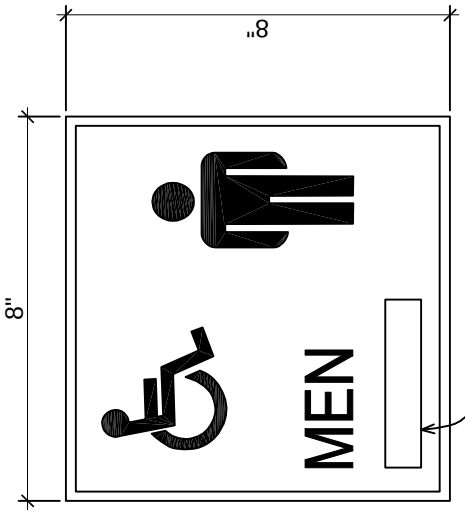

MENS RESTROOM SIGNAGE
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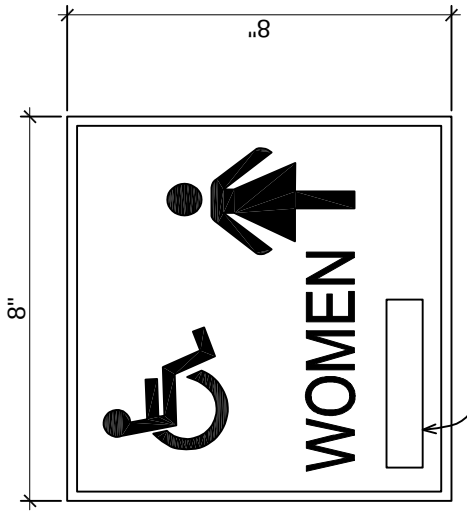

WOMENS RESTROOM SIGNAGE
SCALE = 3"=1"

EFT ARCHITECTS
3D/International Group

265 East 100 South Suite 350
Salt Lake City, Utah 84111-1604
Ph (801) 521-8564 Fax (801) 355-2938

Clearfield DWS-DHS Connection &
2nd Floor Build-out

1350 EAST 1450 SOUTH
CLEARFIELD, UTAH

DFCM PROJECT NO.: 02204920

SIGNAGE DETAILS

DRAWN BY CBJ	CHECKED BY MJT
PROJECT NO. 02204920	DRAWING NO. SIGN-1
DATE Nov. 11, 2002	

SECTION 10520 - FIRE-PROTECTION SPECIALTIES

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. Portable fire extinguishers.
2. Fire-protection cabinets for the following:

   a. Portable fire extinguishers.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

1. Fire Extinguishers: Include rating and classification.
2. 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. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

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:

1. Portable Fire Extinguishers:

a. General Fire Extinguisher Corporation.
b. J.L. Industries, Inc.
c. Larsen's Manufacturing Company.

2. Fire-Protection Cabinets:

a. General Accessory Manufacturing Co.
b. J.L. Industries, Inc.
c. Larsen's Manufacturing Company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A 366/A 366M, commercial quality, stretcher leveled, temper rolled.

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb nominal capacity, in enameled-steel container.

2.4 FIRE-PROTECTION CABINETS

A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.

1. Fire-Rated Cabinets: Listed and labeled to meet requirements of ASTM E 814 for fire-resistance rating of wall where it is installed.

a. Construct fire-rated cabinets with double walls fabricated from 0.0478-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch- thick, fire-barrier material.
b. Provide factory-drilled mounting holes.

2. Cabinet Metal: Enameled-steel sheet.
3. Shelf: Same metal and finish as cabinet.

B. Cabinet Type: Suitable for the following:

1. Fire extinguisher.

C. Cabinet Mounting: Suitable for the following mounting conditions:

1. Semirecessed: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated.

D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

a. Rolled-Edge Trim: 4-inch backbend depth.

E. Cabinet Trim Material: Manufacturer's standard, as follows:

1. Steel sheet.

F. Door Material: Manufacturer's standard, as follows:

1. Steel sheet.

G. Door Glazing: Manufacturer's standard, as follows:

1. Acrylic: Smooth or textured sheet, as follows:

a. Thickness: 6 mm.
b. Color: Clear.

H. Door Style: Manufacturer's standard design, as follows:

1. Fully glazed panel with frame.

I. Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.

1. Provide minimum 1/2-inch- thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
2. Provide inside latch and lock.

J. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide recessed handle with cam-action latch. Provide locking device allowing door to be

opened with sharp pull, and not requiring breaking of glass. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.5 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.

1. Provide brackets for extinguishers not located in cabinets.

B. Door Locks: Provide cylinder lock, with all cabinets keyed alike.

C. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.
2. Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to door.

a. Application Process: Silk-screened.
b. Lettering Color: Black.
c. Orientation: Vertical.

2.6 COLORS AND TEXTURES

A. Colors and Textures: As selected by Architect from manufacturer's full range for these characteristics.

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. Cabinet and Door Finishes: Provide manufacturer's standard baked-enamel paint for the following:

1. Exterior of cabinets and doors, except for those surfaces indicated to receive another finish.
2. Interior of cabinets and doors.

2.8 STEEL FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

B. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets are to be installed.

B. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
2. Fasten mounting brackets to structure and cabinets, square and plumb.
3. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10520

SECTION 10801 - TOILET AND BATH ACCESSORIES

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. Toilet and bath accessories.
2. Infant-care products.
3. Underlavatory guards.

B. Related Sections include the following:

1. Division 10 Section "Toilet Compartments" for compartments and screens.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

C. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.6 WARRANTY

A. General Warranty: Special warranty 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. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:

1. Toilet and Bath Accessories:

a. American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.

2. Infant-Care Products:

a. American Infant Care Products Inc.
b. American Specialties, Inc.
c. Brocar Products, Inc.

3. Underlavatory Guards:

a. Brocar Products, Inc.
b. Truebro, Inc.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.

D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

E. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

A. General: One, maximum 1-1/2-inch- diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

D. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

A. Grab Bar TBA-1: Where this designation is indicated, provide stainless-steel grab bar complying with the following:

1. Stainless-Steel Nominal Thickness: Minimum 0.05 inch.
2. Mounting: Concealed with manufacturer's standard flanges and anchors.
3. Gripping Surfaces: Smooth, satin finish.
4. Outside Diameter: 1-1/2 inches for heavy-duty applications.

B. Mirror Unit TBA-2: Where this designation is indicated, provide mirror unit complying with the following:

1. Stainless-Steel, Angle-Framed Mirror: Fabricate frame from minimum nominal 0.05-inch- thick stainless-steel angles, with square corners mitered, welded, and ground smooth.

C. Mop and Broom Holder TBA-3: Where this designation is indicated, provide mop and broom holder complying with the following:

1. Mop and Broom Holder with Utility Shelf: 36-inch- long unit fabricated of minimum nominal 0.05-inch- thick stainless steel with shelf; support brackets for wall mounting; three hooks for wiping rags; four spring-loaded, rubber hat, cam-

type, mop/broom holders mounted on front of shelf; and approximately 1/4-inch-diameter, stainless-steel rod suspended beneath shelf for drying rags.

D. Diaper-Changing Station TBA-4: Where this designation is indicated, provide infant-care product complying with the following:

1. Horizontal, Surface-Mounted Unit: Diaper-changing station with surface-mounted, mildew-resistant, molded polyethylene body that folds horizontally against wall when not in use; projects not more than 4 inches from wall when closed; and is engineered to support a minimum of 250-lb static weight when opened. Provide unit with pneumatic shock-absorbing operating mechanism and built-in dispenser for sanitary liners.

E. Underlavatory Guard TBA-5: Where this designation is indicated, provide underlavatory guard complying with the following:

1. Insulating Piping Coverings: White, antimicrobial, molded-vinyl covering for supply and drain piping assemblies intended for use at accessible lavatories to prevent direct contact with and burns from piping. Provide components as required for applications indicated with flip tops at valves that allow service access without removing coverings.

END OF SECTION 10801

SECTION 11132 - PROJECTION SCREENS

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. Front-projection screens.

B. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood backing for recessed screen installation.

1.3 SUBMITTALS

A. Product Data: For each type of screen specified.

B. Shop Drawings: Show layout and types of projection screens. Include the following:

1. Location of screen centerline relative to ends of screen case.
2. Anchorage details.
3. Details of juncture of exposed surfaces with adjacent finishes.
4. Frame details.
5. Accessories.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain projection screens through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. Coordination of Work: Coordinate layout and installation of projection screens with other construction supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system, and partitions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed, other construction within spaces where screens will be installed is substantially complete, and installation of screens is ready to begin.

PART 2 - PRODUCTS

2.1 FRONT-PROJECTION SCREENS

A. Material and Viewing Surface of Front-Projection Screens: Provide screens manufactured from mildew- and flame-resistant fabric of type indicated for each type of screen specified and complying with the following requirements:

1. Matte-white viewing surface with gain characteristics complying with FS GG-S-00172D(1) for Type A screen surface.
2. Material: Vinyl-coated glass-fiber fabric.
3. Mildew Resistance: Provide mildew-resistant screen fabrics as determined by FS 191A/5760.
4. Seamless Construction: Provide screens in sizes indicated without seams.
5. Edge Treatment: Black masking borders.
6. Size of Viewing Surface: 7 ft. high x 9 ft. wide

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

1. Matte-White Viewing Surfaces:

   a. Matte White; Bretford Manufacturing, Inc.
   b. Matte White; Da-Lite Screen Co., Inc.
   c. Fiberglass Matte White; Draper Shade & Screen Co., Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and relationship to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

3.2 PROTECTING AND CLEANING

A. Protect projection screens after installation from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 11132

SECTION 12491 - HORIZONTAL LOUVER BLINDS

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 venetian blinds.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of horizontal louver blind specified. Include printed data on physical characteristics.

C. Shop drawings showing location and extent of blinds. Show installation details at and relationship to adjoining work. Include elevations indicating blind units. Indicate location of blind controls.

D. Samples for initial selection in the form of manufacturer's color charts showing the full range of colors, textures, and patterns available for each type of horizontal louver blind indicated.

E. Schedule of horizontal louver blinds using same room designations indicated on Drawings.

F. Maintenance data for horizontal louver blinds to include in the operation and maintenance manual specified in Division 1. Include the following:

1. Methods for maintaining horizontal louver blinds and finishes.
2. Precautions for cleaning materials and methods that could be detrimental to finishes and performance.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide horizontal louver blinds identical to those tested for the following fire-test-response characteristics as determined by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Test Method: NFPA 701.
2. Rating: Pass.

B. Single-Source Responsibility: Obtain each type of horizontal louver blind from one source and by a single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Check actual horizontal louver blind dimensions by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Space Enclosure and Environmental Limitations: Do not install horizontal louver blinds until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. Horizontal Louver Blinds: Before installation begins, furnish quantity of full-size units equal to 5 percent of amount of each size installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Horizontal Louver Blinds:

a. Hunter Douglas, Inc.
b. Levolor Corp.
c. Springs Window Fashions Division, Inc.; (Bali-Graber).

2.2 HORIZONTAL LOUVER BLINDS

A. Louvers: Manufacturer's standard as follows:

1. Aluminum.
2. Nominal Louver Width: 1 inch (miniblinds).

B. Tilt Operation: Manual with wand.

1. Length of Tilt Control: Full length of blind.
2. Position of Tilt Control: Right side, unless otherwise indicated.
3. Tilt: Full.

C. Cord-Lock Operation: Cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

1. Position of Cord Lock: Right side, unless otherwise indicated.

D. Cord Equalizers: Self-aligning to maintain horizontal louver blind position.

E. Valance: Match color of louvers.

F. Mounting: As indicated.

G. Colors and Patterns: Where manufacturer's standard products are indicated, provide horizontal louvers complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors and patterns for horizontal louver blinds of type indicated.

2.3 FABRICATION

A. Product Standard and Description: Comply with AWCMA Document 1029 for each horizontal louver blind unit consisting of louvers, rails, cord locks, tilting mechanisms, tapes, and installation hardware.

B. Lifting and Tilting Mechanisms: Noncorrosive, self-lubricating materials.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Blind Units Installed Between (Inside) Jambs: Width equal to 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch, less than jamb to jamb dimension of opening in which each blind is installed. Length equal to 1/4 inch, plus or minus 1/8 inch, less than head to sill dimension of opening in which each blind is installed.
2. Blind Units Installed Outside Jambs: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Fasteners: Not less than 2 fasteners per bracket, fabricated from metal noncorrosive to blind hardware and adjoining construction; support blind units under conditions of normal use.

E. Hold-Down Brackets: Manufacturer's standard, as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of horizontal louver blinds. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install blinds level, plumb, and located so exterior louver edges in any position are not closer than 1 inch to interior face of glass lites.

3.3 ADJUSTING

A. Adjust components and accessories for proper operation.

3.4 CLEANING

A. Clean blind surfaces, according to manufacturer's instructions, after installation.

B. Remove surplus materials, packaging, rubbish, and debris resulting from installation. Leave installation areas neat, clean, and ready for use.

3.5 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensure that horizontal louver blinds are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 12491

SECTION 12680 - FOOT GRILLES

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 recessed foot grilles and frames.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 3 Sections for concrete work, including forming, placing, and finishing concrete floor slabs, and grouting frames into recess.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design and fabricate foot grilles and frames to withstand and support the effects of a uniformly distributed gravity load of at least 200 psf.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of foot grille and frame specified. Include manufacturer's specifications and installation instructions, details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop drawings showing layout and types of foot grilles and frames, full-scale sections, details of patterns or designs, anchors, and accessories.

D. Samples for initial selection in the form of manufacturer's color charts consisting of actual sections of foot grille and frame materials, showing full range of colors, textures, finishes, and patterns available for each type of foot grille and frame units indicated.

E. Samples for verification in the form of 12-inch square assembled sections of foot grille and frame members and tread rails with the selected tread surface of each type of metal finish and color of exposed grille treads, tread rails, frames, and accessories re-

quired. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

F. Maintenance data in the form of manufacturer's printed instructions for cleaning and maintaining foot grilles.

1.5 PROJECT CONDITIONS

A. Field Measurements: Check actual blocked-out openings in floors by accurate field measurements before fabricating frames and grilles; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain foot grilles and frames from one source and by a single manufacturer.

1.7 COORDINATION AND SCHEDULING

A. Provide oversized recesses in concrete work to receive grille frames. Defer frame installations until building enclosure is completed and related interior finish work is in progress.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Arden Architectural Specialties, Inc.
2. K.N. Crowder Mfg., Inc.
3. Pawling Corp., Standard Products Div.

2.2 MATERIALS

A. General: Provide colors, patterns, and profiles of materials, including metals and metal finishes indicated or specified. Where not indicated, provide colors, patterns, and profiles selected by Architect from manufacturer's full range of products.

1. Extruded Aluminum: ASTM B 221, alloy 6061-T6 or 6063-T5, T6, or T52 as standard with the manufacturer. Coat surface of frame that will contact cementi-

tious material with bituminous coating or other protective coating recommended by the manufacturer.

2. Bituminous Coating: SSPC-Paint 12, solvent type, bituminous mastic, nominally free of sulphur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.

2.3 FRAMES

A. General: Provide manufacturer's standard frame of size and style to fit grille type and to match finish for permanent recessed installation in subfloor; complete with installation anchorages and accessories.

1. Provide frames produced by the same manufacturer as the foot grille.

2.4 FOOT GRILLES

A. General: Provide colors, patterns, and profiles of materials, including tread surface, materials, and finishes, as indicated on Drawings or by these Specifications or, where not indicated, as selected by Architect from manufacturer's full range of colors, patterns, profiles, and finishes.

B. Aluminum Foot Grilles: Provide manufacturer's standard extruded aluminum foot grille with top-surfaced tread rails. Framing members and tread rail material, aluminum finish, tread top surface, and tread rail spacing as indicated.

1. Provide frames for foot grilles of same material as other framing members with finish to match tread rails.
2. Tread Rail Spacing: 1-inch to 1-1/2-inches o.c. with 1/8-inch to 3/16-inch-wide openings between treads.
3. Aluminum Finish: Clear mill finish.
4. Top Surface: Plain serrated aluminum.

2.5 FABRICATION

A. Shop fabricate foot grilles to greatest extent possible in sizes as indicated. Where not otherwise indicated, provide each grille as a single unit, not exceeding manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in grilles are necessary, space symmetrically and away from normal traffic lanes.

B. Fabricate frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by means of straight connecting pins.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install recessed frames and foot grilles to comply with manufacturer's instructions at locations indicated and with top of frames and grilles in relationship to one another and to adjoining finished flooring as recommended by manufacturer. Set grille tops at height for most effective cleaning action and coordinate top of grille surfaces with doors that swing across grilles to provide clearance under door.

3.2 PROTECTION

A. After completing frame installations, provide temporary filler of plywood or fiberboard in grille recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near time of Substantial Completion.

END OF SECTION 12680

SECTION 14240 - HYDRAULIC ELEVATORS

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 hydraulic passenger elevators.

B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for the following:

   a. Preparation of structural steel for fastening guide-rail brackets.

2. Division 5 Section "Metal Fabrications" for the following:

   a. Attachment plates and angle brackets for supporting guide-rail brackets.
   b. Structural-steel shapes for subsills.
   c. Pit ladders.

3. Division 9 Section "Carpet" for finish flooring in elevator cars.
4. Division 15 Section "Fire Alarm Systems" for smoke detectors in elevator lobbies to initiate emergency recall operation and for connection to elevator controllers.
5. Division 16 Sections for electrical service for elevators.

1.3 DEFINITIONS

A. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.

B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure,

relationships with other construction, and locations of equipment and signals. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- square samples of sheet materials; and 4-inch lengths of running trim members.

D. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

E. Maintenance Manuals: Include operation and maintenance instructions, parts listing with sources indicated, recommended parts inventory listing, emergency instructions, and similar information. Include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel. Submit for Owner's information at Project closeout as specified in Division 1.

F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an experienced installer approved by elevator manufacturer who has completed elevator installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Regulatory Requirements: In addition to local governing regulations, comply with applicable provisions in ASME A17.1, "Safety Code for Elevators and Escalators."

1. Seismic Design Category: As indicated on structural drawings.

C. Accessibility Requirements: In addition to local governing regulations, comply with “Americans with Disabilities Act (ADA) Accessibility Guidelines (ADAAG)” and “CABO/ANSI 117.1”, whichever requirements are most stringent.

1.6 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, drains; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by manufacturer agreeing to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: 12 months from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled employees of the elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies as used in the manufacture and installation of original equipment.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service.

a. Response Time: Two hours or less.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering hydraulic elevators that may be incorporated into the Work include, but are not limited to, the following:

1. Montgomery KONE Inc.
2. Otis Elevator Co.
3. Thyssen Elevator Group North America.

2.2 MATERIALS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components, published by manufacturer as included in standard preengineered elevator systems and as required for a complete system.

B. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide either of the following:

1. Pump, with fan-cooled squirrel-cage induction motor, mounted on top of oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- thick, glass-fiber insulation board.
2. Submersible pump, with submersible squirrel-cage induction motor, suspended inside tank from vibration isolation mounts.
3. Provide motor with wye-delta or solid-state starting.

C. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.

D. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Specification Section.

F. Car Frame and Platform: Welded steel units.

G. Finish Materials: Provide the following materials and finishes for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated:

1. Satin Stainless Steel: ASTM A 666, Type 304, with No. 4, directional satin finish.
2. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGP for postformed applications and Type HGS for flat applications; color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range of products.

2.3 OPERATION SYSTEMS

A. Passenger Elevators: Provide manufacturer's standard microprocessor operation system for each elevator or group of elevators as required to provide type of operation system indicated.

1. Single Elevator, Two Stops: Provide "automatic operation" as defined in ASME A17.1.

B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated.

1. Battery-Powered Lowering: When power fails, cars are lowered to the lowest floor, open their doors, and shut down. System includes rechargeable battery and automatic recharging system.

2.4 SIGNAL EQUIPMENT

A. General: Provide signal equipment for each elevator or group of elevators with hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements of acrylic or other permanent, nonyellowing translucent plastic.

B. Car Control Stations: Provide fully recessed car control stations with applied metal faceplates. Mount in return panel adjacent to car door, if not otherwise indicated.

1. Include call buttons for each landing served and other buttons, switches, and controls required for specified car operation.
2. Mark buttons and switches with manufacturer's standard identification for required use or function that complies with ASME A17.1.

C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Car Position Indicator: For passenger elevator cars, provide illuminated-signal type, digital-display type, or segmented type, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.

1. Include travel direction arrows if not provided in car control station.

E. Hall Push-Button Stations: Provide hall push-button stations at each landing.

1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
2. Provide units with direction-indicating buttons.

F. Lanterns: Provide units with illuminated arrows, but provide single arrow at terminal landings.

1. Place lanterns in both jambs of entrance frame for each elevator. Mount at a minimum of 72 inches above finished floor.

   a. At manufacturer's option, lanterns may be located in car doorjambs instead of entrance jambs.

2. With each lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

2.5 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with a uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

1. Nudging Feature: After car doors are prevented from closing for a predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.6 PASSENGER ELEVATOR CAR ENCLOSURES

A. General: Provide manufacturer's standard steel-framed car enclosures with nonremovable wall panels, suspended ceiling, trim, accessories, access doors, doors, power door operators, sills (thresholds), lighting, and ventilation.

1. Floor finish is specified in another Section.
2. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch fire-retardant-treated particleboard with plastic-laminate panel backing complying with NEMA LD 3, Type BKV and manufacturer's standard protective edge trim. Panels have a flame-spread rating of 75 or less, when tested according to ASTM E 84.
3. Fabricate car with recesses and cutouts for signal equipment.
4. Fabricate car door frame integrally with front wall of car.
5. Stainless-Steel Doors: Flush, hollow-metal construction, fabricated from stainless steel.
6. Sills: Extruded metal, with grooved surface, 1/4 inch thick.
7. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic complying with flammability requirements.
8. Handrails: Manufacturer's standard handrails, of metal indicated.

2.7 PASSENGER HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. Materials and Fabrication: Provide manufacturer's standards but not less than the following:

1. Stainless-Steel Frames: Formed stainless-steel sheet.
2. Stainless-Steel Doors: Flush, hollow-metal construction, fabricated from stainless steel.
3. Sills: Extruded metal, with grooved surface, 1/4 inch thick.

4. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

2.8 PASSENGER ELEVATORS

A. Elevator:

1. Type: Holeless, single-acting, beside-the-car, dual cylinder.
2. Rated Load: 2500 lb.
3. Rated Speed: 100 fpm.
4. Auxiliary Operations:

    a. Battery-powered lowering.

5. Car Enclosures: As follows:

    a. Inside Width: 80 inches.
    b. Inside Depth: 51 inches.
    c. Inside Height: 96 inches.
    d. Front Walls: Satin stainless steel with integral car door frames.
    e. Car Fixtures: Satin stainless steel.
    f. Side and Rear Wall Panels: Plastic laminate.
    g. Reveals: Satin stainless steel.
    h. Door Faces (Interior): Satin stainless steel.
    i. Door Sills: Aluminum.
    j. Ceiling: Luminous ceiling.
    k. Handrails: Satin stainless steel , at side and rear walls.
    l. Floor prepared to receive carpet (specified in Division 9 Section "Carpet").

6. Hoistway Entrances: As follows:

    a. Width: 42 inches.
    b. Height: 84 inches.
    c. Type: Single-speed side sliding.
    d. Frames: Satin stainless steel.
    e. Doors: Satin stainless steel.
    f. Sills: Aluminum.

7. Hall Fixtures: Satin stainless steel.
8. Additional Requirements: As follows:

    a. Provide inspection certificate in each car, mounted under acrylic cover with satin stainless-steel frame.
    b. Provide protective blanket hooks and complete set of full-height blankets.
    c. Provide signage at elevator entrances complying with local regulations and instructing occupants of building to use stairs and not use elevator in case of fire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions, and examine supporting structure and other conditions under which elevator work is to be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance.

3.2 INSTALLATION

A. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

B. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.

C. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cement fittings.

D. Lubricate operating parts of systems as recommended by manufacturers.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

F. Leveling Tolerance: 1/4 inch, up or down, regardless of load and direction of travel.

G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of operational failure and other building emergencies. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete elevator maintenance program.

B. Make a final check of each elevator operation with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

3.5 PROTECTION

A. Temporary Use: Do not use elevators for construction purposes unless cars are provided with temporary enclosures, either within finished cars or in place of finished cars, to protect finishes from damage.

1. Provide full maintenance service by skilled, competent employees of elevator Installer for elevators used for construction purposes. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Use same parts and supplies as used in the manufacture and installation of original equipment.
2. Provide protective coverings, barriers, devices, signs, and other procedures to protect elevators. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

END OF SECTION 14240

SECTION 15010 - GENERAL PROVISIONS

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 GENERAL CONDITIONS

A. The contractor shall carefully read the General Conditions of the Contract and all information to bidders which, with the following specifications for heating, cooling, plumbing, fire protection, exhaust ventilation, and temperature control are a part of the Contract.

1.3 BASIC BID

A. Shall include all labor and materials specified in this division.

1.4 SCOPE OF WORK

A. The work to be done under this section includes the furnishing of all labor, materials, equipment, controls and accessories required to complete all heating, air conditioning, ventilating, plumbing, drainage, and other mechanical systems as shown on plans and/or described in these specifications, including miscellaneous items required to provide a complete and functional facility.

B. All work shall be coordinated with Division 1. Work shall include, but shall not be necessarily limited to, the following:

1. System commissioning
2. Testing
3. Balancing
4. Insulation systems
5. Roof drain system
6. Air distribution system
7. Hot water heating systems
8. Exhaust systems
9. Automatic control systems
10. Air conditioning system
11. Plumbing systems
12. Special systems

C. The mechanical contractor shall provide all miscellaneous electrical work and control wiring for special systems where the wiring requirements are provided by the equipment manufacturers and/or suppliers, unless all of the required wiring is clearly shown on the electrical drawings to be provided by the electrical contractor.

1.5 CODES AND ORDINANCES

A. All work shall be installed in accordance with the city, state, and local plumbing codes, and all other codes, ordinances, and regulations which govern the type of work covered by these specifications.

B. Should the drawings conflict with the code, the code shall govern the proper installation of the work, and no extra charge shall be made for such change.

C. Should the contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility company regulations, he shall bear all costs arising in correcting the deficiencies.

D. Where the work required by the drawings and specifications exceeds the minimum code requirements, the work shall be done as shown or specified.

NOTE: Code compliance, or similar terminology, shall be interpreted to mean "the interpretation of the code as enforced by the local building authority".

1.6 DRAWINGS AND SPECIFICATIONS

A. These specifications are intended to cover all labor, material, and standards of mechanical workmanship to be employed in the work shown on the drawings, called for in these specifications, or reasonably implied by terms of same. The drawings and specifications are intended to supplement one another, and any part of the work that may be mentioned in the one and not represented in the other shall be done the same as if it had been mentioned or represented in both.

B. Large scale drawings shall take precedence over layouts and small scale details.

C. The mechanical drawings are schematic in nature, and show the general arrangement of all piping, ductwork, mechanical equipment, and appurtenances. They shall be followed as closely as the actual building construction and the work of other trades will permit.

D. Due to tight structural conditions and space limitations in selected areas the contractor should anticipate structural and space conflicts, and shall make allowances for them in his bid. Until the steel fabrication shop drawings are submitted for review, the mechanical coordination cannot be completed.

E. The architectural and structural drawings shall be considered part of the mechanical work insofar as these drawings furnish this Division with information relating to design and construction of the building. Architectural and structural drawings take precedence over the general building layouts and details shown on the mechanical drawings.

F. The structural engineer and architect shall approve all attachments to or modifications of any structural members in the building required for installation of the mechanical systems.

G. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories which will actually be required. This contractor shall investigate the structural and finish conditions affecting the work and provide all necessary offsets, fittings, valves, trim, and accessories required to meet actual job-site conditions.

1. Dimensions -
   Verify dimensions governing mechanical work at the building. No extra compensation shall be claimed or allowed on account of differences between the actual job-site dimensions and those indicated on the drawings.

2. Adjoining work -
   Examine all adjoining work on which the mechanical work is dependent and report any work which must be corrected. No waiver of responsibility shall be claimed or allowed due to failure to report unfavorable conditions affecting the mechanical work.

1.7 INTERPRETATION OF DRAWINGS AND DOCUMENTS

A. If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the plans, specifications, or other proposed contract documents, or finds discrepancies in or omissions from the drawings or specifications, he may submit to the Architect, a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the proposed documents will be made only by addenda duly issued, and a copy of such addenda will be mailed or delivered to each person receiving a set of such documents. The Owner will not be responsible for any other explanations or interpretations of the proposed documents. All questions shall be submitted at least seven days in advance of bidding.

B. The Architect will interpret the meaning of any part of the drawings and specifications about which any misunderstanding may arise, and his decisions will be final. Should there appear to be any error or discrepancy in or between the drawings and specifications, the contractor shall refer the matter to the Architect

for adjustment before proceeding with the work. Should the contractor proceed with the work without so referring the matter, he does so on his own responsibility.

1.8 WORKMANSHIP

A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Architect.

1.9 SUBSTITUTIONS

A. See Division 1 Section "Product Requirements" pertaining to Substitutions.

1.10 FEES & PERMITS

A. This contractor shall obtain all necessary permits and pay all fees required in connection with the work.

B. Requirements of the local utility companies shall apply at the time of bidding. Contractor shall have checked with the local utility companies, and shall determine from them gas meter and piping which they will require to be installed, and shall figure cost of same in his bid. Questar fees will be paid by this contractor.

C. This contractor shall coordinate with DFCM and Division 1.

1.11 SITE INSPECTION AND EXAMINATION OF DRAWINGS

A. The contractor shall carefully study all drawings and specifications pertaining to the work. If any of the work as laid out, indicated, or specified is contrary to or conflicts with any governing ordinances or regulations, the same shall be reported to the Architect before submitting a bid. The Architect will then issue instructions as to procedure.

B. The contractor shall carefully examine the building site and compare the drawings with existing conditions. By the act of submitting a bid, the contractor shall be deemed to have made such examination, to have accepted such conditions, and to have made allowance therefore in preparing his bid.

1.12 VERIFICATION OF DIMENSIONS:

A. Before proceeding with any work, the contractor shall carefully check and verify all dimensions, sizes, etc., and shall assume full responsibility for the rigging and fitting-in of his ductwork, piping, and equipment. Where apparatus and equipment has been indicated on the drawings, dimensions have been taken from typical equipment of the class indicated. The contractor shall carefully check the drawings to see that the equipment he is required to install will fit into the spaces

provided, and will allow for proper maintenance and service of the equipment.

1.13 COORDINATION

A. This contractor shall coordinate his work with other specification divisions and shall provide all necessary specialty items, trim, and incidental 115 volt and 24 volt power and control wiring (which is not shown or specified under other divisions) required to provide a complete functional acceptable system.

B. The Division 15 contractor shall coordinate his work such that all slots and openings through floors, walls, ceilings, and roofs are properly located and shall do any cutting and patching caused by neglecting to do so.

1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into the construction as the work proceeds.

2. It is the responsibility of Division 15 to located these items and see that they are properly installed.

C. The locations of all piping, ducts, apparatus, and equipment indicated on the drawings are approximate only, and shall be changed as required to meet the actual architectural and structural conditions at the job site. All changes shall be approved by the Architect. Any change in work which has not been installed shall be made by the contractor without additional compensation, except changes which are caused by architectural and structural changes which substantially increase the size of any of the mains, or which substantially increase the number of fixtures or length of pipe runs. Any and all changes shall be made only upon approval of a written change order.

1. Right of way - Lines which pitch shall have the right of way over those which do not pitch. For example, plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have right of way over lines whose elevations can be changed.

D. Offsets, transitions, and changes in direction in pipes and ducts shall be made as required to avoid conflicts with building footings and foundationsor other buried ducts or utilities, and to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions and changes in direction.

E. It shall be each contractor's responsibility to verify exact location, elevation, and/or route of the various mechanical system components with architectural details and with Architect's personnel on job.

F. Where deviations from locations and/or arrangements described are necessary to

meet actual job conditions, the changes shall be made without cost to the Owner.

G. The Architect reserves the right to make any reasonable change in location of any outlet, piping, or equipment, before installation, without additional cost.

1.14 LOCATION OF CEILING OUTLETS

A. This contractor shall assist the Architect, General Contractor, Electrical Contractor and other interested parties in the establishment of room centerlines, axis of rooms and all walls.

B. All grilles, registers, ceiling diffusers, etc. shall be located with reference to these established data points.

C. These outlets shall be referenced to such features as room centerlines, walls and ceiling furrings, balanced border widths, etc.

D. Outlets in acoustical tiles, panels, etc. shall occur in joints or centers of whole pieces, etc.

E. The final determination of the exact location of all outlets shall be subject to the direction and approval of the Architect.

1.15 PROVISIONS FOR REMOVAL & ADEQUATE CLEARANCE

A. Install Mechanical work to permit removal of heating and cooling coils, filters, belt guards, sheaves, drives, and other parts requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.

B. Arrange pipes, ducts, and equipment to permit ready access to filters, valves, cocks, traps, starters, motors, control components, and to clear the openings of swinging doors and access panels.

1.16 RECORD DRAWINGS

A. The contractor shall maintain one set of record drawings. These prints shall show the location, elevations and details of all items of work installed under this contract. Buried piping shall be located by dimensions from foundation walls and depths of bury shall be indicated. These shall be marked in red. The completed set of record drawings must be submitted to the Architect before the contractor is eligible to receive the final payment. An up-to-date record set of drawings shall be maintained during the progress of the project, and be available to the Architect upon request.

1.17 COORDINATION DRAWINGS

A. The contractor shall provide coordination drawings, when requested by the Architect, to insure that the various mechanical system components are coordinated with each other, and with other building systems.

B. The coordination drawings shall be drawn to scale (usually 1/4" = 1'-0") and shall show all systems as they relate to each other, especially in areas of potential conflict.

C. Equipment room coordination drawings shall include, in addition to the information specified, the size and location of all piping, pipe fittings, valves, strainers, specialties, flexible connections, water treatment devices, control panels, etc., and their installed elevation.

D. Equipment room coordination drawings shall show the location of all pertinent electrical outlets, lights, panels, transformers and switch gear, and their required clearances from duct, piping, and equipment, and for maintenance access.

E. Footing and foundation coordination drawings shall be prepared showing the exact location, depth, and slope of all buried piping to be installed. These coordination drawings shall include all sand and grease interceptors, drains in depressed slab areas, and all necessary buried water piping.

F. This set of foundation coordination drawings shall be maintained in the construction trailer and shall be marked up daily to indicate exact location and elevation of all buried piping and conduit systems.

G. Coordination drawings shall be professionally drafted and shall be clear and concise in their presentation and clarity.

H. All coordination drawings shall be prepared in digital format on AutoCad Release 14.0. Material shall be submitted in both printed and disk form.

I. All ductwork and piping attachments to the building structure shall be detailed, and shall be coordinated with the Architect.

1.18 COOPERATION WITH OTHERS

A. The contractor shall so organize the work that progress will harmonize with the work of all trades, so that all work may proceed as expeditiously as possible. The contractor shall be held responsible for any delays which might be caused by his negligence or failure to cooperate with other contractors or crafts.

1.19 FOREMAN

A. A full-time foreman shall be designated by the contractor to the Architect and shall be available on site for consultation. This individual, when appointed, will not be replaced without prior approval from the Architect. The foreman shall be

responsible for the coordination and correct placing of the work.

1.20 GUARANTEE

A. By the acceptance of the contract award for the work herein described, the contractor assumes the full responsibility imposed by the guarantee as set forth herein and should protect himself through proper guarantee from equipment and specialty manufacturers and subcontractors as their interests may appear.

B. All materials and equipment provided and installed under this division of the specifications shall be guaranteed for a period of one (1) year from the date of substantial completion and acceptance by the Owner, unless specifically noted elsewhere in the specification. Should any trouble develop during this period due to defective materials or workmanship, the contractor agrees to correct the trouble without any cost to the Owner, any defect noticed at the time of installation and/or during the guarantee period shall be corrected immediately to the satisfaction of the Owner.

1.21 SCHEDULES, MATERIALS AND EQUIPMENT

A. As soon as practicable, and within 30 days after date of award of contract, and before commencement of work, a complete schedule of equipment and materials proposed for installation shall be submitted to the Architect. The schedule shall include catalogs, cuts, drawings, and such other descriptive data or samples that are requested by the Architect. Schedules shall include all items of equipment used. No partial submittals will be accepted.

B. Provide nine (9) corrected copies of each required shop drawing or similar submittal to the Architect for review, approval, and return of two (2) copies. DO NOT SUBMIT without general contractor's signed stamp, indicating the general contractor has reviewed the submittal for completeness and conformance to the Contract Documents.

C. Inform the Architect by notation, or in the letter of transmittal, of any proposed deviation from the requirements of the Contract Documents.

D. Provide required shop drawings or other submittals within time stipulated on approved progress schedule.

E. Do not commence work requiring a shop drawing or other submittal until approval of the required submittal has been received. Such approval will be based upon a review only for conformance with the design concept of the project and with the information given in the Contract Documents, and does not relieve the contractor from responsibility for errors or omissions in the shop drawings.

F. Schedules shall be neatly bound in hard-backed looseleaf binders. Schedules

shall be completely indexed, and shall include the following items:

1. Boilers
2. Heating coils
3. Chiller
4. Cooling coil
5. Circulators
6. Valves
7. Finned radiation
8. Hot water & chilled water specialties
9. Flow meters
10. Plumbing fixtures
11. Piping systems
12. Pipe supports & restraints
13. Air handling unit
14. Packaged split system air conditioning units.
15. Fan/Coil units.
16. Exhaust air fans
17. Pressure gauges & thermometers
18. Reduced Pressure Backflow Preventer
19. Fire safing system with installation diagrams
20. Seismic restraints
21. Vibration isolators
22. Filter banks
23. Dampers
24. Louvers
25. Medium pressure ducts
26. Medium pressure fittings
27. Medium pressure flexible ducts
28. Low pressure flexible ducts
29. Grilles & registers
30. Diffusers
31. VAV boxes
32. Insulation systems
33. Automatic temperature controls
34. Air balance contractor qualifications
35. System commissioning contractor's qualifications
36. Other schedule items

G. Submittals received which do not contain all of the above items will be returned unchecked.

H. Purpose and Contractor's Responsibility: The purpose of the final submittal is to "assist the contractor selecting the equipment." The contractor shall review the submittals prior to submission to the Architect to make sure that the submittals are complete in all details including the following items:

1. Manufacturers' names shall be mentioned in specifications as accepted by Owner at time of bidding.

2. Equipment dimensions shall be verified to fit the spaces provided with sufficient clearances, as may be required by the equipment or indicated on the drawings.

3. Equipment shall be reviewed with respect to schedules, specifications, plans and details.

4. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment.

I. Review: Review and acceptance of submittal does not relieve the contractor of his responsibility to fulfill the contract requirements. Review and acceptance of the submittal will not be used as a means of changing the contract requirements. Items not covered in the accepted submittal, or items incorrectly covered but not recognized or identified, shall not be used when contrary to the requirements of the contract documents.

J. Acceptance of Substitute Equipment: If the proposed installation is approved, this contractor shall make all incidental changes in piping, ductwork, supports, installation, wiring, heaters, panel boards, and as otherwise necessary. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for the proper operation of the system resulting from the contractor's selection of alternate equipment, including all required changes in the effected trades.

K. Owner's Refusal Right: In the event that items submitted are substitutions for specified items and are found to be not acceptable, the right shall be reserved to require the specified items.

1.22 OPERATING INSTRUCTIONS AND CATALOG INFORMATION

A. This contractor shall compile in looseleaf binders catalogs of every product used by him in the completion of the work. The binders shall also include copies of the test data (Section 15042), balancing reports (Section 15043), and system commissioning data (Section 15030). Before final acceptance by the Architect, he shall turn over to the Owner this compilation of catalog data. A double index shall be provided, one giving an alphabetical list of products for which catalogs are included, and one giving their addresses, whose products are included in the work. Provide data for each item of equipment listed in SCHEDULES, MATERIALS & EQUIPMENT, as shown in Section 15010. Provide copy of submittal data. Four (4) copies shall be delivered to the Architect for his approval.

B. Provide warranty schedule and schedule of overload protection as required in Section 15030.

C. Binders shall be white vinyl with see-thru front and end panels identified as follows:

DWS/DHS 2nd FLOOR
DAVIS COUNTY EMPLOYMENT CENTER
OPERATING & MAINTENANCE MANUAL
DFCM PROJECT NO. 98002920
2002
SET #

PART 2 - PRODUCTS

2.1 MATERIALS, EQUIPMENT AND ACCESSORIES

A. Unless otherwise specified, all equipment, accessories, and materials shall be new and undamaged, and the workmanship shall be of the best quality for the use intended and shall be acceptable to the Architect.

B. Equipment, accessories, and materials shall be essentially the standard products of the manufacturer, or as specified herein. Where two or more units of the same class of new equipment are required, these units shall be products of a single manufacturer.

C. Should mechanical equipment other than that used in the design be furnished, it shall be the responsibility of the mechanical subcontractor to provide large scale (1/2" = 1'-0") installation drawings, as required, showing service and maintenance points with proper clearance allowances for service.

D. All equipment shall be selected to deliver full rated capacity at the job site elevation.

PART 3 - EXECUTION

3.1 FUNCTIONING AND OPERATION OF EQUIPMENT

A. Contractor's Responsibility: Installation and startup shall be so made that its several component parts will function together as a workable system, and shall be left with all equipment properly adjusted and in working order.

3.2 CLEANING AND PATCHING BY MECHANICAL CONTRACTOR

A. The contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is

responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

3.3 INSTRUCTIONS TO OWNER'S REPRESENTATIVES

A. The mechanical contractor shall provide, without expense to the Owner, competent instructors to train the Owner's representatives in the care, adjustment, maintenance, and operation of all parts on the heating, air conditioning, ventilating, plumbing, and automatic temperature control systems and equipment. Training shall be a minimum of 24 hours with no less than 8 hours for ATC training.

B. Instruction date shall be scheduled with the owner at the time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect.

C. No training shall begin until system commissioning is complete and accepted by the owner.

3.4 PROTECTION AGAINST THE ELEMENTS

A. The contractor shall, at all times, take reasonable and adequate precautions to protect his work and all stored materials and equipment from damage by the elements, including flooding, windstorms, etc., and shall not expose the work of any other contractor to such damage.

B. In addition to requirements specified in Division 01, stored material shall be readily accessible for inspection by the Architect until installed.

C. All items subject to moisture damage, such as controls, shall be stored in dry, heated spaces.

D. Protect all bearings during installation, and thoroughly grease steel shafts to prevent corrosion.

3.5 REMOVAL OF DEBRIS, ETC.

A. Upon completion of this division of the work, remove all surplus material and rubbish resulting from the work, and leave the premises in a clean and orderly condition.

3.6 MOTORS & STARTERS

A. This contractor shall furnish all motors required and necessary to operate equipment furnished by him. The voltage, phase, and horsepower of each motor shall be coordinated with the electrical contractor prior to ordering.

3.7 OPENINGS FOR MECHANICAL SYSTEMS

A. All openings required for installation of mechanical systems shall be provided by the mechanical contractor. Any piece of equipment which is to be installed in any space of the building and which is too large to permit access through stairways, doorways or shafts shall be brought to the job by the Contractor involved and placed in the space before the enclosing structure is completed. Materials shall be delivered at such stages of the work as will expedite the work as a whole.

3.8 SAFETY REGULATION

A. The contractor shall comply with all local and OSHA safety requirements in performance with this work. (See General Conditions). This contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

END OF SECTION 15010.

SECTION 15030 - SYSTEM COMMISSIONING

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 DESCRIPTION:

A. The work required under this section shall include, but not necessarily be limited to, the following:

1. The pre-startup inspection of all systems by a qualified systems commissioning contractor, and coordinating of the subsequent correction of any incorrect items.

2. Repair, replacement, or adjustment of each item shall be performed by the installing contractor.

3. System operations inspection.

B. The intent of this section is to provide for proper installation, startup, service, and operation of the mechanical systems in preparation for system balancing. See Section 15043 for balancing.

1.3 PRE-STARTUP INSPECTION:

A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.

B. All pertinent items shall be checked and listed on forms included in this section. Items shall include, but not necessarily be limited to, the following:

1. Removal of shipping stops.
2. Vibration isolators and seismic snubbers properly aligned and adjusted.
3. Flexible connections are properly aligned.
4. Belts are properly adjusted.
5. Belt guards and safety shields are in place.
6. Safety controls, safety valves, and high or low limits are properly installed and functioning.
7. All systems are properly filled.

8. Filters are in place with a proper seal around their edges.
9. Fire dampers are properly installed, linked, and serviceable.
10. Pressure and temperature gauges of the proper size and range are installed.
11. All test stations and measuring devices are properly installed and functioning.
12. Initial lubrication of equipment is complete.
13. Filters and strainers are clean.
14. Motor rotations are correct.
15. Voltages match nameplates.
16. Control system is operating properly.
17. All interlocks are wired and verified.
18. All controls have been connected and verified.
19. All valves, dampers, and operators are properly installed and operating.
20. All ductwork is installed and connected.
21. All roof-mounted equipment is properly flashed.
22. All water and chemical feed piping is either heat taped, or located in spaces which are heated to prevent freezing.
23. Piping which is run above the roof or is otherwise subjected to freezing is properly heat taped and insulated.
24. All other items necessary to provide for proper start-up.
25. All seismic restraints are in place and secured.
26. All condensate drain lines are piped to discharge in proper drains.

1.4 FIRST RUN INSPECTION:

A. Recheck all items outlined in pre-startup inspection to insure proper operation.

B. Check the following items:

1. Excessive vibration or noise.
2. Loose components.
3. Initial control settings.
4. Motor amperages.
5. Heat buildup in motors, bearings, etc.
6. Control system is sequencing properly, calibrated and functioning as required.
7. Heat tapes are wired & functioning.

C. Correct all items which are not operating properly.

1.5 SYSTEM OPERATION INSPECTION:

A. The mechanical systems shall be observed under operation conditions for sufficient time to insure proper operation under varying conditions, such as daylight and heating-cooling.

B. Periodically check the following items:

1. Strainers and filters.
2. Visual check of air flow for "best guess" setting for preparation for system air balancing under Section 15043.
3. Control operation of time clocks, on-off sequences, system cycling, etc.
4. Visual checks for water flow, seals, packings, safety valves, operating pressures and temperatures.
5. Cleaning of excessive oil or grease.
6. Dampers close tightly.
7. Valves close tightly.
8. System leaks.
9. All other items pertaining to the proper operation of the mechanical system, whether specifically listed or not.

1.6 WARRANTY SCHEDULE:

A. Provide a list in each O & M Manual of all motors, fans, and equipment with manufacturer's names, models, serial numbers and date of startup approved by the Architect, date of warranty, extent of warranty, and equipment supplier with address and phone numbers.

1.7 SCHEDULE OF OVERLOAD PROTECTION:

A. Provide a list in each O & M Manual of all motors with size, voltage, amperage, and size and rating of overload protection.

1.8 REPORT:

A. Prior to the start of system balancing the system commissioning sub-contractor shall submit completed forms and provide a detailed written report to the owner's representative outlining the results of the system commissioning work for each system and piece of equipment which lists any un-corrected system abnormalities.

1.9 CERTIFICATION:

A. Provide written certification of all tests, and start-up procedures. Bind a copy of this certification in the O & M manuals. Certification shall include an itemized list of systems serviced during the system commissioning process with dates, times, and a complete description of the work completed, and the name of the responsible system commissioning mechanic.

END OF SECTION 15030.

SECTION 15042 - TESTING

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 DESCRIPTION

A. The work outlined in this section shall be performed by the several trades involved.

B. The mechanical contractor shall provide all supervision, labor, materials, tools, scaffolding, and equipment required to complete all system testing.

C. The mechanical contractor shall remove and repair any defective component as indicated by the system tests and retest.

D. The mechanical contractor shall test the operation of all safety and high limit controls to insure proper installation and operation. Any defective devices shall be replaced.

1.3 TESTS AND ADJUSTMENTS

A. Before any piping is covered, tests shall be made in the presence of the Owner's Representative, and any leaks or defective work corrected. No caulking of threaded work will be permitted.

B. Before application of insulation covering, and as far as practical before concealing any piping, all piping shall be hydrostatically tested and proved tight.

C. Stubs shall be capped and all control valves shall be removed during the test.

D. System may be tested in sections, providing connections to last section tested are included in each succeeding test.

E. Following minimum pressures shall be used for testing:
1. Refrigerant piping as required in 15050.
2. Domestic hot and cold water piping at 100 psig for six hours.
3. Plumbing waste and vent piping at 10 ft. head for six hours.
4. Rainwater piping at 10 ft. head for six hours.
5. Medium pressure air ducts in accordance with SMACNA standards.

6. Heating hot water and chilled water system piping at 150 psig for six hours.

F. All valves and equipment which may be damaged shall not be subjected to the test pressure.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The contractor shall furnish all necessary gauges, plugs, test fans, pumps, etc., as required to conduct the tests.

2.2 REPORTS

A. The contractor shall give the Architect one week notice prior to performing the tests. All tests shall be recorded and copies of reports bound in the O & M manuals and given to the Owner.

PART 3 - EXECUTION

3.1 PROCEDURE

A. The contractor shall be responsible to conduct all tests in a safe manner, protecting the work of other trades from water or physical damage.

B. The tests, as indicated, shall be in addition to any test, as required, by any governing agency. Submit all approved tests, as required, by any governing agency to the Architect.

C. Each test and any necessary repairs and retest shall be performed by the contractor which installed the system.

D. Upon completion, a test shall demonstrate that the culinary hot water system is circulating, that all traps are properly vented, that there is an ample supply of hot and cold water to fixtures, that no fixture or equipment can be back-syphoned, and that there are no back-flow connections.

END OF SECTION 15042.

SECTION 15043 - BALANCING

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 SCOPE OF WORK

A. The mechanical contractor shall employ an independent technical firm to perform the checking, adjusting, and balancing (CAB) of the HVAC systems. This firm shall be one whose operations are limited to the field of professional CAB, and this firm shall meet the following qualifications:

1. The firm shall be a member of AABC or NEBB, and shall be one which is organized to provide professional services of this specific type.

2. The firm shall have completed projects of similar scope within the past 12 months and shall be capable of performing the services specified at the location of the facility described within the time frame specified, and following up the basic work as may be required.

3. All personnel used on the job site shall be engineering technicians, who shall have been permanent, full-time employees of the firm for a minimum of six (6) months prior to the start of the work for this project.

B. As a part of this contract, the mechanical contractor shall make all changes in the sheaves, belts, and dampers, including the addition of dampers required for correct balance as required by the CAB firm, at no additional cost to the Owner.

C. The mechanical contractor shall provide and coordinate services of qualified, responsible subcontractors, suppliers, and personnel as required to correct, repair, or replace any and all deficient items or conditions found during the testing, adjusting, and balancing period.

D. In order that all systems may be properly checked, balanced, and adjusted as required by these specifications, the mechanical contractor shall operate said systems at his expense for the length of the time necessary to properly verify their completion and readiness for the CAB and shall further pay all costs of operation during the CAB period.

E. The project completion schedule shall be coordinated with the CAB work to provide

sufficient times to permit the completion of CAB services prior to Owner occupancy.

1.3 DOCUMENTS

A. The Owner's representative will furnish, without charge to the CAB firm, one set of mechanical specifications, all pertinent change orders, and the following:

1. One complete set of plans less the structural sheets.
2. One set of mechanical floor plans of the conditioned spaces.

B. These sheets should be ozalid type (blue or black on light background) reproductions to facilitate marking.

C. Approved submittal data on equipment installed to accomplish the test procedures outlined in paragraph "Services of the CAB Firm" of this specification will be provided by the mechanical contractor.

D. The Owner's representative will transmit one copy of the following "Records for Owner" to the CAB firm for review and comments:

1. Record drawings
2. Approved fixture brochures, wiring diagrams, and control diagrams.
3. Shop drawings
4. Instructions
5. Motor and valve charts
6. Operating and Maintenance Manuals

1.4 SERVICES OF MECHANICAL CONTRACTOR

A. The mechanical contractor shall have all systems complete, calibrated, and in operational readiness prior to notifying the CAB firm that the project is ready for their services. The mechanical contractor shall coordinate system readiness with the system commissioning contractor and shall certify in writing to the Owner's representative that the system is complete and ready to balance.

1.5 SERVICES OF THE CAB FIRM

A. The technical CAB firm shall submit biographical data on the individual proposed to directly supervise the CAB work. It shall also submit their record of specialized experience in the field of air and hydronic system balancing.

B. Act as liaison between the Owner's representative and contractor and periodically inspect the installation of mechanical piping systems, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems as the installation progresses. The inspection will cover only those parts of the systems relating to the checking and balancing.

C. To check, adjust, and balance system components to obtain optimum conditions in each conditioned space in the building.

D. Prepare and submit to the Owner's representative, complete reports on the balance and operations of the systems.

E. The CAB firm shall be responsible for inspecting, adjusting, balancing, and logging the data on the performance of the following general systems, including all components.

1. Heating water systems, including pumps, air handling units, coils, controls, etc.
2. Freon compressor systems, including chillers, condensing units, DX coils, heat exchangers, controls, etc.
3. Temperature control system in its entirety, includes the verification of all control sequences and safety devices.

F. Before any adjustments are made, the air systems are to be checked for such items as dirty filter, duct leakage, damper leakage, equipment vibrations, correct damper operations, etc.

G. Before any adjustments are made to water systems, the strainers shall be cleaned, temperature control valve operation shall be checked, pump rotation shall be checked, pressure reducing valves shall be adjusted, etc.

H. It shall be the responsibility of the CAB personnel to check, adjust, and balance the components of the various systems as listed above using an applicable "proportionate balance procedure" in order that each of them will operate under optimum noise, temperature and air flow conditions in the conditioned spaces in the building "while simultaneously operating at the most energy efficient condition."

I. During the balancing process, if abnormalities or malfunctions of equipment or components are discovered by the CAB personnel, the owner's representative shall be advised promptly so that the condition may be corrected by the project contractor. Data from malfunctioning equipment or components shall not be recorded in the final CAB report.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND INSTRUMENTS

A. This contractor shall provide all necessary labor, equipment, scaffolding, instruments, and materials required to adjust, balance, and check all systems.

PART 3 - EXECUTION

3.1 REPORT

A. The activities, as described hereinbefore, will culminate in a report to be provided to the Architect. This report shall be furnished in six (6) copies. One copy shall be bound in each O & M manual. The intent of the final report is to provide a reference of actual operating conditions for the building operating personnel.

B. The CAB report shall include the following as a minimum:

1. Preface: A general discussion of the systems, any idiosyncrasies, any problems encountered, an outline of normal sequence of operation for the HVAC system cycles, any un-corrected noise problem.

2. Pitot Tube Traverses: For use in future trouble-shooting by maintenance personnel, all exhaust ducts, main supply ducts and return ducts will have air velocity and volume measured and recorded by the traverse method. Locations of these traverse test stations will be described on the sheet containing the data.

3. Temperature Tabulation: Of all conditioned spaces on a room-by-room basis, a total of at least three readings will be taken of each room on successive days. Record outside ambient temperature at two-hour intervals. The total variation in conditioned space temperatures shall not exceed 2 deg. variance from the thermostat settings.

4. Air Volumes and Velocities: As measured at each supply grille, return air grille, and exhaust air grille or air handling device. In all fan systems, the air quantities indicated on the plans may be varied as required to secure a maximum temperature variation of two degrees within each separately controlled space, but the total air quantity indicated for each zone must be obtained. It shall be the obligation of the contractor to furnish or revise fan drive and/or motors, if necessary, without cost to the Owner, to attain the specified air volumes.

5. Air Pressure: As measured across each supply fan, cooling coil, heating coil, air handling unit filter and exhaust fan. Relate these readings to the particular fan curve in terms of CFM handled at the various static pressures, and their relationship to fan power and fan instability.

6. Water Temperature: Shall be taken entering and leaving the coils and heat exchangers under maximum load conditions in each case.

7. Water Pressure: At all gauge connections, pressure readings at coils and pumps shall be related to coil and pump curves in terms of gpm handled and confirmed by gpm flow thru Venturi units at each air handler. The flow of water thru all water coils shall be adjusted by manipulating valves until

the rated pressure drop across each coil is obtained and total water flow is verified by Venturi readings. On those with 3-way valves, rated pressure drop shall first be adjusted thru the coils in each of the several systems and the temperature differential between inlet and outlet shall be determined to be in each of the several systems and the temperature differential between inlet and outlet shall be determined to be in accordance with its rating. The bypass valves shall then be adjusted on each coil until an equal pressure drop between supply and return connections is obtained with the three-way valves set to bypass all coils in each of the several systems.

8. Electrical Current/Voltage: Measurements to be taken at the drive motor on each piece of equipment.

9. Fan Speeds: To be measured in RPM.

10. Instrumentation List: A list of instruments by type and make used in gathering the CAB data.

11. Drawings: The CAB contractor's working drawings shall have the VAV, and fan powered boxes and supply air openings numbered and/or lettered to correspond to the numbers and letters used on the report data sheets so that data in the report can be correlated with each specific supply air opening in the building. If room numbers actually used in the building differ from those on the plans, the building room numbers shall be marked on these plans. Only one such marked-up set of drawings need be provided with the six copies of the CAB report.

C. Before final acceptance of the CAB report, the report data, at the discretion of the Architect, shall be verified one time on the job site, by selection of check points (not to exceed 10 percent of total) at random, in the presence of the Architect. Representatives of the testing firm doing the work shall be present and provide the necessary equipment for test data verification.

D. The firm shall be responsible for inspecting, adjusting, balancing, and logging the data on the performance of fans, all dampers in the duct system, all air distribution devices, the flows of freon or water thru all coils, and the power consumption of all motors.

E. During the CAB work, the temperature regulation will be adjusted for proper relationship between controlling instruments. The Architect will be advised of any instruments out of calibration so that the controls subcontractor may come in and recalibrate, using data supplied by the balancing firm.

F. Make a total of three inspections within ninety (90) days after occupancy of the building to insure that satisfactory conditions are being maintained throughout and to satisfy and unusual conditions.

G. An additional inspection in the building shall be made by the firm during the season opposite that in which the initial adjustments were made. At that time, any necessary modifications to the initial adjustment required to produce optimum operation of the system components shall be made to produce the proper seasonal conditions in each conditioned space.

H. At the time of opposite season checkout, the Architect shall be given timely notification before any readings or adjustments are made so that they may participate in the checkout.

END OF SECTION 15043.

SECTION 15050 - BASIC MATERIALS AND METHODS

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 DESCRIPTION

A. This section specifies the basic materials and methods to be used in Division l5 work.

1.3 MATERIALS & EQUIPMENT

A. All materials shall be new and undamaged. Protect all stored materials and equipment from damage by the elements, including exposure to excessive heat, flooding and rain, windstorms, etc.

B. All materials and equipment shall be installed in strict compliance with the manufacturer's recommendations.

1.4 CUTTING AND PATCHING

A. Any cutting, patching, or filling necessary for the proper execution of this work, except as noted on drawings, shall be done by this contractor.

B. No rough or unsightly work will be allowed. Cutting of structural members shall be done only on approval of the Architect.

C. The attention of the contractor is directed to the requirements of running pipes thru concrete slabs, walls, and beams. These conditions are to be anticipated and sleeves installed as provided for under "Sleeves".

1.5 INSERTS

A. Furnish and set, in all necessary locations, before or during construction, unistrut inserts for use in connection with the support and seismic restraint of piping, ductwork, and equipment furnished under this division of the work.

1.6 SLEEVES

A. Sleeves for Concrete or Masonry Surfaces:

1. For pipes passing thru masonry or concrete construction, provide sleeves at least two pipe sizes larger than the pipe passing thru and made from sections of steel pipe.

2. Provide galvanized iron sleeves with collar on each side of wall for all ducts passing thru masonry or concrete construction.

3. Provide 22 gauge sheet metal collars on each side of wall for all ducts passing thru gypsum wall construction or similar construction.

4. Sleeves shall be placed in structural members only where approved by the Architect.

5. Sleeves through foundation walls below grade shall be mechanical seal type with watertight sealing grommets and pressure rings. Sealing grommets shall be non-melting at temperatures incurred. Foundation wall sleeves shall be "O.Z. Type WSK".

B. Sleeves thru Finished Surfaces: For pipes passing thru finished partitions or ceilings, provide galvanized sheet iron sleeves of suitable size. The sleeves shall be fastened to construction to prevent creep along pipe and the sleeve ends shall be flush with finished surfaces. Provide escutcheon plates at each side of finish wall or floor or ceiling for all pipes passing thru same.

C. Sleeves thru Fire-rated Surfaces: All pipe sleeves and ductwork penetrating fire walls and surfaces shall be packed inside after pipes amd/or ducts have been placed with a U.L. listed fire safing system. Refer to Division 7 Section "Through-Penetration Firestop Systems" for requirements.

D. Sleeves thru Sound Rated Surfaces: All pipe sleeves and ductwork penetrating sound rated walls or surfaces shall be packed with dense fiberglass, sealed with duct sealer and fitted with metal cover flanges on both sides.

E. Sleeves thru Floors: Sleeves thru floors above grade shall extend 1" above the floor and shall be sealed watertight with waterproof silicone caulking.

1.7 PIPE LOCATION AND ARRANGEMENT

A. No water supply piping inside the building shall be placed in direct contact with the earth. Buried water piping shall be placed in split tile or PVC pipe to keep pipe from direct contact with ground.

B. Unless otherwise noted on the drawings, all water piping shall be kept out of concrete floor slabs.

C. Under no circumstances shall plastic piping or ducting materials be run inside of supply or return air plenums.

D. All piping shall be properly racked and supported to run straight and true.

E. All changes in direction shall be made with approved fittings. Pipes shall not be bent to change direction.

F. All piping shall be racked and run to facilitate maintenance work. Under no circumstances shall valves, shock absorbers, drip traps, or piping specialties be installed in a "closed space" without proper access provided for future maintenance. See "Access Doors" section of specifications.

NOTE: All piping shall be capped or plugged at the end of each work shift and when not being extended, to prevent the entry of rocks and debris.

G. Any time lines are broken or disconnected, they shall be capped immediately after flushing to remove rock and debris from pipes. **If rocks or other foreign materials are found in the system after it has been closed, the contractor shall stand the expense of their removal.**

H. All valves, piping, and equipment to be installed so as to permit disassembly for maintenance purposes.

I. Provide drain valves at all low points in piping systems. Run to floor drain where possible, otherwise provide 3/4" hose connection with vacuum breaker.

1.8 PIPE JOINING

A. All steel pipe under 2" in size shall be joined by screwed connections. Heating hot water and chilled water piping may be welded if pipe size is over 2" in size.

B. Welded ends shall be plain beveled. Welding fittings must be employed if welding is used. Small (1-1/2" and smaller) branch connections may be made with Weldolets or Thredolets provided themain is at least 2" dia., and not less than two pipe sizes larger than the branch. Where these connections are used, the pipe opening in the main shall be cut to insure a full inside pipe diameter at the branch connection. Slag and spelter resulting from the hole cutting shall be removed from the main piping.

C. All joinings shall be made to maintain the full metal strength of the pipe, with neat and workmanlike appearance.

D. All piping must be perfectly clean before the system is filled.

E. Copper Piping in Domestic Water Service: Piping shall be cut (with a pipe cutter) so ends are square and will "bottom" in fittings. There must be no gaps left thru

which solder can run into the line. If a hack saw must be used, it shall be guided with a mitre box to insure a square, even cut. Tubing shall be reamed to remove burrs, being careful not to expand tubing while reaming.

F. The outside of the copper pipe and the inside of the fittings, where solder will be applied, shall be burnished with fine crocus cloth or fittings brushes until all dirt and oxide is removed.

G. A light coat of soldering flux shall be applied to both pipe and fittings. **Acid flux shall not be used.**

H. Joints in copper pipe shall be uniformly heated to proper soldering temperature to insure that solder will flow to **all parts** of the joint. The solder shall be fed to the joint until a uniform line of solder appears around the pipe at the end of the fittings.

I. Copper piping used in domestic water service shall be joined with 'Stay-Safe-50' or 'Silvabrite-100' no lead solder.

J. When valves are being installed in copper piping, the non-metallic parts shall be removed to prevent the heat of soldering from damaging the valves. No heat shall be applied near where an excessive temperature may cause damage.

K. Victaulic type couplings, fittings, and valves may be used for chilled, and heating water piping when fabricated and installed in strict compliance with the manufacturer's recommendations.

L. Qualification of Welders: Welders performing work under this Contract shall be certified and qualified in accordance with tests prescribed by the National Certified Welding Bureau (NCWB) or by other approved test procedures using methodology and procedures covered in the ASME Boiler and Pressure Vessel Code, Section IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators."

M. Submit for approval the names, identification, and welder's assigned number, letter or symbol of welders assigned to this project.

N. The assigned identification symbol shall be used to identify the work of each welder and shall be indelibly stamped immediately upon completion of each weld.

O. Welders shall be tested and certified for all positions.

P. Submit identifying stencilled test coupons made by each operator.

Q. Any or all welders may be required to retake welding certification tests without additional expense.

R. When so requested, a welder shall not be permitted to work as a welder on this

project until he has been recertified in accordance with NCWB.

S. Recertification of the welder shall be made after the welder has taken and passed the required tests.

T. Where piping 1-1/2 inches and smaller is to be butt or socket welded, submit 3 samples of test welds for approval.

1.9 SCREWED CONNECTIONS

A. All pipe shall be reamed at the ends and free of all inside scale or burrs. Threads shall be cut clean and sharp, and to a length equal to 1-l/8 the length of the female thread receiving the pipe. The pipe shall be screwed in the full length of the female thread.

B. Pipe shall be made tight with teflon thread tape or thread lubricant worked into male thread only. Surplus material shall be wiped off and the joint left neat and clean. Lubricant shall be powdered graphite and linseed oil, or plumbage and linseed oil.

1.10 MECHANICAL GROOVED PIPING CONNECTIONS

A. At installers option, mechanical grooved pipe couplings and fittings may be used on heating hot water and chilled water systems for piping systems 2-1/2" and above and having operating conditioning not exceeding 230 deg. F. excluding steam piping and any other service not recommended by manufacturer, instead of welded, flanged or threaded methods, and may also be used as unions, seismic joints, flexible connections, or vibration reducers.

B. Couplings shall consist of one of more piece housing, synthetic rubber gasket, with nuts, bolts, locking pin, locking toggle or lugs to secure unit together. Housing shall be ASTM A-536 ductile cast iron or ASTM A-47 malleable iron, hot dip galvanized or zinc electroplated. Coupling housing shall be painted with alkyd enamel paint.

C. Gasket shall be molded of synthetic rubber in a central cavity, pressure-responsive configuration conforming to the pipe outside diameter and coupling housing. Gasket material shall be selected for the specific service as recommended by the manufacturer.

D. Fittings shall be full flow fittings with grooves or shoulders designed to accept grooved end couplings. Standard fittings shall be ASTM A-536 ductile cast iron or ASTM A-47 malleable iron. Standard steel fittings including large size elbows (16" - 24"), shall be forged steel conforming to ASTM A-106. Standard segmentally welded fittings shall be fabricated of Schedule 40 carbon steel pipe.

E. AWWA cast iron fitting shall be ASTM A-48 Class 30-A gray cast iron or ASTM A-

536 ductile cast iron, conforming to the requirements of AWWA/ANSI C-110.

F. Outlet fittings for branches, gauges, meters or other specialty items shall be a standard mechanical product.

G. Fittings for plain end steel pipe shall consist of cast housing with internal pipe stops, quarter turn positive locking lugs, and self-contained, pressure-responsive gaskets. Housing shall be ASTM A-536 ductile cast iron or ASTM A-47 malleable iron, hot dip galvanized or zinc electroplated. Coupling housing shall be painted with an alkyd enamel paint.

H. All mechanical grooved couplings shall be of the same manufacturer. Either flexible or rigid type to be used as required.

I. Approved Manufacturers: Victaulic or Grinnell.

1.11 PIPE GRADING

A. Piping shall be uniformly graded in direction of flow as noted below:

PIPING	FALL/RISE	DIRECTION	PER/RUN
Rainwater	1"	Down	4'
Water	1"	Up	40'
Waste - 4" & smaller	1"	Down	4'
Vent	1"	Up	4'
Condensate Drip	1"	Down	4'
Htg. Water/Glycol	1"	Up	40'
Chilled Water/Glycol	1"	Up	40'
Refrigerant	1"	Down	40'

1.12 EQUIPMENT BASES

A. Pumps, tanks and other equipment shown on the plans shall be set on 4" high concrete pads. The pads shall be furnished by Division 3300. The mechanical contractor shall coordinate pad size and location with the general contractor.

B. Roof curbs shall provide a free height from the roof membrane to the top of the curb of at least 12". All roof curbs and platforms shall have a wood nailer strip around the top perimeter for securing the roof membrane and attaching roof flashings. Flashings by Division 7.

1.13 VIBRATION ISOLATION

A. Care shall be taken by this contractor to prevent the transmission of vibration from equipment to building structure. Flexible connectors shall be installed in all piping connecting to pumps, air handling units, and other flexibly mounted equipment.

B. Flexible connection shall be specifically designed to absorb noise and vibration and to prevent damage to equipment caused by piping stress. Unit construction shall consist of heavy bellows type neoprene rubber hose sections with stainless steel liners and attachments to match piping, or three (3) grooved flexible couplings for grooved pipe systems.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

A. All piping shall be in accordance with the American Society for Testing and Materials, ASTM A-53. No foreign made piping or connectors will be accepted in this construction.

B. Culinary cold, hot, and recirculating hot water above grade shall be Type "L" copper with soldered wrought copper fittings.

C. Rainwater and waste piping below slabs shall be standard weight cast iron pipe with M-G or tyseal gasketed fittings.

D. Rainwater and waste piping above grade shall be standard weight cast iron pipe with no-hub, tyseal, M-G, or A.B.I. 'Best' gasketed fittings for sizes 2" and larger; and galvanized Schedule 40 with tarred Durham drainage fittings for 1-1/2".

E. Heating hot water piping and chilled water piping above grade shall be Schedule 40 black steel pipe.

F. Condensate drip lines shall be Type "M" copper with soldered wrought fittings.

G. Culinary and heating hot water below slab shall be Type ‘K’ soft copper. No fitting allowed below slab. Piping below slab to be encased in a Schedule 40 PVC pipe with long sweep elbows. Casing to terminate 1" above slab. PVC casing to be two pipe sizes larger than carrier pipe but be 2" minimum.

H. Refrigeration piping shall be Type "L" copper with malleable copper fittings. Piping shall be specifically treated and sealed for refrigeration systems piping, similar to Mueller.

NOTE: Pre-charged line sets will be permitted on refrigeration systems with rated capacities below 65,000 BTUH.

NOTE: All exposed piping, fittings, valves, and trim in kitchen area shall be chrome plated.

I. Underground water (irrigation) piping shall be schedule 40 PVC.

J. Underground sanitary sewer and storm drain piping shall be schedule 40 PVC drain, waste, and vent line.

2.2 HANGERS AND SUPPORTS

A. Vertical Piping: Attachment - Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and to carry the weight of the pipe and contents. Stacks shall be supported at their bases, and if over two (2) stories in height at each floor by approved metal floor clamps.

1. Cast iron soil pipe shall be supported at not less than each story height and at its base.

2. Screwed pipe (IPS) shall be supported at not less than every other story height.

3. Copper tubing shall be supported at each story for piping one and one-half (1-1/2) inches in diameter and at not more than six (6) foot intervals for piping one and one-quarter (1-1/4) inches in diameter and smaller. Piping shall be wrapped with three wraps of vinyl tape to isolate pipe from ferrous pipe supports.

B. Horizontal Piping: **Under no circumstances shall piping be supported from the metal roof deck.**

1. It is essential that all piping be supported from roof structure at joist panel point locations.

2. Supports - Horizontal piping shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

3. Cast Iron Soil Pipe - Where joints occur, soil pipe shall be supported at not more than 5-foot intervals, except that where 10-foot pipe lengths are used, supports at 10-foot intervals are acceptable. Supports shall be placed within eighteen (18) inches of the hub or joint. No-hub joints and fittings shall be restrained with rods and clamps per manufacturer's recommendations.

4. Screwed pipe (IPS) shall be supported at approximately 12-foot intervals.

5. Copper tubing shall be supported at approximately 6-foot intervals for

piping one and one-half inches and smaller in diameter and at 10-foot intervals for piping two inches and larger in diameter.

6. Piping placed underground shall be laid on a firm bed for its entire length.

7. Hangers shall be Grinell Figure 260 for both bare and insulated pipe.

8. Not used.

9. Where piping is run adjacent to walls or steel columns, it shall be supported from steel brackets or vertical channel hangers. Brackets shall be Grinell Figure PS 732 or PS 3282 as directed, or approved substitute. Channel systems shall be approved for each condition on an individual basis.

10. Furnish all hangers, inserts, brackets, anchors, guides, sliding supports, etc., and all auxiliary steel necessary for the installation. All supports shall be designed in accordance with the AISC Steel Handbook and painted with one shop coat of primer paint.

11. Insulation inserts and shields for cold surface piping will be provided under Section 15180 of these specifications.

12. Pipe covering protection saddles shall be installed at all pipe hangers which support insulated "hot surface" piping. Saddles shall be tack welded to the piping and shall match the insulation thickness applied.

13. All copper, fiberglass, or plastic piping shall be securely supported from the building structure at intervals specified and/or as recommended by the pipe manufacturer. Hanger shields for suspended piping shall be functionally similar to isolators with Grinnell Fig. 97. Non-ferrous piping shall be isolated from contact with ferrous supports with three wraps of vinyl tape.

14. All piping in mechanical equipment rooms shall be supported with vibration control hangers.

15. Plumbers' tape, chain, or wire will not be permitted for pipe support.

2.3 VALVES AND STRAINERS

A. All valves and strainers shall be by one manufacturer. Approved valve manufacturers are Crane, Nibco, W. C. Norris, Grinnel, or Powell. Crane numbers are used for convenience.

B. Heating, Cooling, and Domestic Hot and Cold Water:

1. Gate Valves: Valves 2" and smaller shall be Crane No. 428, bronze, screwed, 200# WOG gate valve with solid wedge disc and rising stem.

NOTE: If unable to use a rising stem valve because of insufficient clearance, use a Crane No. 438 nonrising stem valve.

2. Globe Valves: Valves 1-1/2" and smaller shall be Crane No. 37, bronze, screwed, 200# WOG globe valve with a replaceable teflon disc and teflon packing. The disc shall be suitable for hot water up to 360 deg. F. at 150 psi.

3. Check Valves: Valves 1-1/2" and smaller shall be Crane No. 37, bronze, screwed, Y-pattern 200# WOG swing check valve. Valves 2" and larger shall be Crane No. 373.

4. Butterfly Valves: Valves 2-1/2" and larger shall be Crane No. 23N-BRB iron body and disc, lug type, stainless steel stem, 200# WOG EPT Nordel seat rated for 275 deg. F butterfly valve.

   NOTE: Valves 4" and smaller shall be equipped with the proper size 10 position Multi-lock hand lever. Valves 5" and larger shall be equipped with the proper size Extra Power Manual weather proof gear operator.

6. Ball Valves: For hot and cold domestic water service: Valves 2" and smaller shall be Crane No. 2190H bronze, screwed, 200# WOG, Gem ball valve with Buna-N rubber capsule. Watts B6000 or Apollo 70-100.

7. For heating service as isolation or balancing valves: Valves 2" and smaller shall be Crane No. 219H, bronze, screwed, 200# WOG, Hydro Gem ball valve with EPT Nordel capsule. (If solder-joint ball valves are desired, use Crane No. 2192H). NOTE: Valves must be suitable for temperature and pressure required in the individual application.

8. Strainers: Strainers 1-1/2" and smaller shall be Crane No. 988-1/2, iron body, screwed Y-pattern, 200# WOG, sediment separators with a 20-mesh Monel screen.

   a. All strainers shall be installed with fine mesh supplementary "construction screens" which shall remain in place while the system is flushed and chemically cleaned. The "construction strainer" basket shall be removed just prior to balancing the water systems.

   b. Provide blow-down ball valve on all strainers same size as strainer tapping.

2.4 NON-SLAMMING OR SPRING LOADED CHECK VALVES

A. Types: Provide valves of the fully guided or cone-and-diaphragm types.

B. Bodies: Provide flanged or wafer type bodies constructed of cast iron ASTM A 126, Class B; cast steel ASTM A 216/A 216M, Class WCB; stainless steel, Type 304 or cast bronze ASTM B 61.

C. Trim: Seats, discs and springs shall be constructed of 18-8 stainless steel or bronze complying with ASTM B 62. Seats may be of elastomers suitable for 250 degrees F. minimum continuous working temperature or not less than 50 degrees F. above the operating temperature of the system, whichever is higher.

D. Mating Surfaces: Mating surfaces of closure faces shall be bronze or Type 316 or 17-4PH stainless steel or elastomer approved for the particular service and materials must be compatible to prevent electrolytic action.

E. Pressure Loss: Pressure loss through the valves, measured in feet of water, shall not exceed 6/10 of the water velocity in feet per second.

F. Bubble-Tight: Non-slamming and spring loaded check valves shall provide bubble-tight shut-off when handling water up to 250 degrees F. and 125 pounds per square inch differential pressure. Design shall prevent rubbing of seat materials when opening and closing. Poppet valves shall have conical springs.

2.5 GENERAL DUTY VALVES & SPECIALTY COCKS

A. Cocks:

1. Balancing cocks 1-1/2" and smaller shall be Crane No. 80E, bronze, screwed, 200# WOG.

2. Balancing cocks 2" and larger shall be Crane No. 325, all iron, flanged 125# WOG.

3. Gas cocks 2" and smaller shall be Crane No. 270, flat head, bronze screwed.

4. Gage cocks shall be Crane No. 744, 1/4", bronze, screwed.

5. Pet cocks shall be Crane No. 702, 1/4", bronze, screwed with lever handle.

6. Try cocks shall be Crane No. 734, 3/8", bronze, screwed, 250# rated with stuffing box.

7. Provide two complete sets of wrenches for all cocks and stops.

2.6 VALVES FOR GROOVED END PIPE

A. General:

1. Provide valves with pressure rating clearly marked on valve body.

2. Unless otherwise specified provide valves of the same size as the upstream pipe size.

3. Valves shall be of the same manufacturer as the grooved end pipe products.

B. Ball Valve: Ball valves 1-1/2" to 6" shall be Victaulic 721 "Vic-Ball" with bubble tight shut-off at 600 psi WOG or equal of Grinnell. Body/end cap shall be cast of ductile iron conforming to ASTM A-536 with Endurion corrosion resistant coating, stainless steel ball, TFE seats.

C. Butterfly Valve:

1. Butterfly valves 2" to 12" shall be Victaulic 700, 703, 704, 707 and "Series 300" with bubble tight shut-off at 200 psig to 300 psig depending on style. Carbon steel body or ductile iron. Zinc plated or PPS coated body, aluminum bronze, chrome plated ductile iron, stainless steel or encapsulated synthetic elastomer coated disc. Dual piece stem or drive hub and trunnion mounted disc. Handle shall be std on-off, latchlock, infinitely variable or gear operated as required for intended service.

2. In systems requiring insulation, all butterfly valves shall have extended necks. Valve neck must be designed with sufficient length to accept 2" of insulation without inhibiting actuator in any way.

D. Swing Check Valve: Check valves 2" to 4" shall be Victaulic 712 fabricated with ASTM A-536 ductile cast iron housing, bonnet cap, and bonnet closure. 300 psi working pressure. Full port opening, 316 stainless steel clapper, EPDM disc seat permanently bonded to the valve body.

E. Non-Slam Check Valve: Check valves 4" to 12" shall be Victaulic 710 or 711, 714, or 715 "Vic-Check II". Silent, springloaded, 400 psig wp. ASTM A-536 ductile cast iron or ASTM A-47 malleable iron housing, alumminum discs, 316 stainless steel shaft and spring, nylon bushings, EPDM disc seat permanently bonded to the valve body.

2.7 PIPE SPECIALTIES FOR GROOVED END PIPE

A. Strainer: Strainers 2" to 12" shall be Victaulic 730 "Vic-Strainer". Straight through pattern, ASTM A536 ductile cast iron bodywith grooved ends, 304 stainless steel 20 mesh screen, 0.033" openings. Provide ball valve on drain connection and run drain line to nearest floor drain.

B. Suction Diffuser:

1. Suction diffusers shall be Victaulic 731, one piece ASTM A-536 ductile cast

iron or ASTM A-47 malleable iron body with outlets drilled, tapped, and plugged either side for pressure or temperature gauges and at the bottom for drain connection. Access end cap shall be of the same material as the body.

2. Basket shall be of type 304 stainless steel 0.041" wire in a woven no. 6 mesh wire screen with 0.126" opening, welded securely to a heavy frame of like material, in a convoluted configuration.

3. Flange connection to pump shall mate to ANSI Class 125 or Class 150 pump flange.

C. Dielectric Waterway: Dielectric waterways shall be Victaulic 47 or Perfection Corporation, ASTM A-120, standard weight, galvanized steel, Schedule 40 pipe with grooved by threaded ends. PVC lining permanently bonded to the interior of the pipe.

D. Flow Metering System: Flow measuring systems shall be Victaulic 733 Venturis Sensor or 734, 734S Orifice/Indicators. Grooved end type designed to accept grooved mechanical coupling without field preparation. Meters and sensors are designed for 250 psig working pressure. Venturis sensors to be compatible with systems having flows of .2 GPM and larger. To be used in systems that require water balancing. Orifice/Indicators shall be used for systems requiring flow measuring devices.

E. Vic-O-Let: Strapless outlet shall be Victaulic 923 cast of ductile iron conforming to ASTM A-536 or malleable iron conforming to ASTM A-47. Rated at 300 psi working pressure. Gasket shall be for the specific service as recommended by the manufacturer. Collar shall be hot rolled, pickled and oiled steel conforming to ASTM A-569.

F. Vic-O-Well: Strapless outlet shall be Victaulic 924 cast of ductile iron conforming to ASTM A-47. Rated at 300 psi working pressure. 6" insertion well. Gasket shall be for the specific service as recommended by the manufacturer. Collar shall be hot roller, pickled and oiled steel conforming to ASTM A-569.

2.8 BACKFLOW PREVENTERS

A. Backflow preventers shall comply with requirements of the International Plumbing Code as to type, style, size, location, and arrangement for the actual installed duty.

B. Where backflow preventers are installed which release water thru the valve to the atmosphere, these units shall be provided with drip pans which collect the free water. The drip pans shall be piped to the nearest drain.

C. All backflow preventers shall be installed with all necessary isolation valves and test cocks.

2.9 AUTOMATIC VALVES AND WELLS

A. The mechanical subcontractor shall install the automatic temperature control valves, temperature sensing wells, and flow switches, as directed by the automatic temperature control subcontractor.

2.10 UNIONS

A. Ground joint unions shall be installed on pipe 2-1/2" and under where indicated on drawings. Whenever piping is connected to a major piece of apparatus, unions shall be provided as near as practical on each side of the apparatus.

2.11 ISOLATION FITTINGS

A. Approved isolation fittings shall be installed at the junction of all copper and steel piping to prevent electrolytic action. Fittings shall be as manufactured by Walter Vallett Co., Corrosion Services, or approved equal.

2.12 THERMOMETERS

A. General: Provide liquid-in-glass type thermometers or Vari-angle digital thermometers as manufactured by Weiss unless bimetal dial type is required due to space limitations or other conditions.

B. Scale and Dial: Provide liquid-in-glass thermometers of the organic liquid type having a nominal scale length of not less than 7 inches. Provide bimetal dial thermometers with a nominal 5-inch dial size graduated through a minimum arc of 270 degrees. Provide a recessed dial so that graduated portion and pointer are in the same plane.

C. Range: Temperature range shall be as shown on the drawings or as specified. Chilled water system 20 degrees F. to 120 degrees F. Hot water system 30 degrees F. to 240 degrees F. Condenser water system 30 degrees F. to 240 degrees F.

D. Case: Provide liquid-in-glass type thermometer with an aluminum alloy or steel case. Provide bimetal dial thermometers with all exposed metal parts, including the case and stem made of 300 Series stainless steel, all welded construction.

E. Accuracy and Calibration: Bimetal dial thermometers shall have zero adjustment for recalibration and shall have an accuracy of plus or minus one percent of span through the complete range. Liquid-in-glass thermometers used for indicating shall have an accuracy of plus or minus 0.5 degree F. Unless otherwise required in other sections of the specifications, thermometers for commissioning tests shall have an accuracy of plus or minus 0.25 degree F.

F. Thermometers measuring temperature for energy calculations shall have an accuracy of plus or minus 0.1 degree F.

G. Thermometer Wells: Provide pipe line liquid-in-glass thermometers with a union connection, tapered bulb chamber and matching taper on well. Provide bimetal dial thermometers with a well to match bulb chamber. Provide wells for insulated pipe of the extension neck type suitable for insulation thickness. Provide wells fabricated of bronze, brass or 316 stainless steel suitable for the fluid or gas in the pipe.

H. Stem: Provide stems with a minimum length of 2-1/2 inches immersion which shall be increased in length as necessary to reach the center lines of the pipes in which they are installed.

I. Adjustment: Provide straight or angle pattern adjustable type thermometers as required to facilitate readings.

J. Thermometers shall be Palmer, Trerice, Marsh or Weiss. Install all thermometers so as to be easily readable from the floor.

2.13 PRESSURE GAUGES

A. General: Provide pressure gauges which comply with ANSI B40.1.

B. Dials: Provide dials not less than 4-1/2 inches in diameter, except that packaged equipment may be provided with manufacturer's standard gauges of equal accuracy.

C. Ranges: Select operating ranges so that during normal service the gauge pointer will be at the approximate midpoint of the gauge scale.

D. Refrigerant Gauges: Provide refrigerant pressure gauges with corresponding temperature scales for the particular refrigerant sensed.

E. Accuracy: Pressure gauges used for commissioning of other equipment shall have a minimum accuracy of 3 percent of span.

F. Gage Cocks: All gages shall be furnished with gage cocks and pressure snubbers.

G. Gauges shall be Ashcroft, Trerice, or U.S. Gage.

2.14 PRESSURE & TEMPERATURE TEST PLUGS

A. Plugs shall be brass body type with Neoprene, Nordel, or Vitron self-closing valve (to suit temperatures of fluid in pipe). Test plugs shall be Pete's Plug or approved substitute. Furnish six pressure and six temperature instruments to Owner to

permit reading pressures and temperatures.

2.15 FLOW MEASURING AND BALANCING SYSTEMS

A. Furnish and install complete the Venturi and calibrated orifice Flow Metering Systems as shown on the drawings.

B. This shall be a coordinated system with individual Venturi Flow Stations supplied by one manufacturer and each individual calibrated orifice supplied by one manufacturer.

C. On pipe sizes 3/4-inch diameter and smaller, provide calibrated balancing valves on runouts to fan coil units, fin tube radiation, convectors and reheat coils.

D. Fittings shall be of the combination balancing and shut-off type with the balancing device positioned by an Allen set screw or other approved method which permits closing of the valves without disturbing its balanced position.

E. Bodies may be of the globe or "Y" type with contour flow plug or approved equivalent.

F. Provide a graduated dial or other device to indicate the valve setting.

G. Gland shall permit packing under pressure.

H. Materials and construction shall be as specified for water valves sizes 1-1/2-inch and smaller.

I. On sizes 3/4-inch and smaller ends may be sweat or compression type.

J. Each station shall be complete with quick disconnect valves and safety shut-off valves, metal identification tag on chain giving pipe size, meter series, station identification, and meter reading at specified flow rate. Metering stations shall be selected so that design flow rate shall be between 10 and 40 inches of water pressure differential with permanent pressure loss of not more than 25% of indicated flow rate differential pressure.

K. The calibrated flow metering valves shall be selected to deliver the rated flows at the mid-point of their set-point range.

L. A master meter shall be furnished to the owner for maintenance purposes.

M. Venturi Flow Metering System shall be by Barco Engineering Company or Robertson. Calibrated orifice system shall be Bell & Gossett, Armstrong, or Taco.

2.16 V-BELT DRIVES

A. Capacity of V-belt drives at rated RPM shall be not less than 150 percent of motor nameplate horsepower rating.

B. V-belt drive combinations shall be limited to A, B, C, and fractional horsepower belts. 3V, 5V, and 8V belts and sheaves shall not be used.

C. Drives requiring single belt application shall be of the adjustable pitch type. Multiple belt drives shall be of the non-adjustable type. All fixed pitch sheaves, including single groove fan sheaves, shall be of the bused type. Fixed bore sheaves will not be acceptable for non-adjustable pitch sheaves.

2.17 MISCELLANEOUS ITEMS

A. Motors: Motors shall be furnished and installed under the applicable Mechanical Sections of the Specifications.

B. Each motor shall be provided with a nameplate for the electrical characteristics shown on the Drawings or as otherwise noted.

C. Motors shall be constructed and rated to deliver full nameplate capacity at the project altitude.

D. Horsepower shall be at least equal to that shown on the drawings. Where equipment is submitted and approved for the installation which requires larger motor sizes than shown, the wire and starter sizes shall be increased and means provided for operation and control suitable for the larger motors with no increase in cost to the Owner.

E. Unless otherwise specified, or required for controller sequencing, all motors over 5 HP shall be high efficiency type, and all fractional HP single phase motors 1/2 HP & under shall be permanent split capacitor (PSC) type.

F. Motors for V-belt drives shall be provided with cast iron or steel base, with slide rail and adjustable screw device and shall be isolated by rubber-in-shear devices.

G. Motors shall have sufficient capacity to start and operate the machine it drives without exceeding the motor nameplate rating at the speed specified or at any speed and load which may be obtained by the drive actually furnished.

H. Motors provided with automatic control shall be capable of making as frequent starts as the control device may demand. Motors not provided with automatic control shall be capable of making not less than 4 starts per hour.

I. All belt-connected motors, regardless of size, shall be equipped with shafts and bearings that will withstand both the normal belt pull of the drive furnished and the momentary or continuous overloads due to acceleration of incorrect belt tension.

J. Motors shall be air cooled, and shall be guaranteed to operate continuously at 115% of full load with temperature rise in any part not to exceed 40 degrees C above the ambient air temperature.

K. Motors shall be open drip-proof or totally enclosed fan cooled type as required, and shall be commercially dynamically balanced and tested at the factory before shipment.

L. Motors shall be selected for quiet operation. Sound power levels shall be within NEMA MGI-12.49.

M. Motors shall comply with requirements of ANSI C 50, NEMA MG-1, and all NEMA standards.

N. Motors controlled by variable frequency drives shall have characteristics which are fully compatible with the drives to which they are connected. Provide written confirmation of coordination with VFD supplier.

O. Approved Manufacturers: Allis-Chalmers, Century, Gould, Lincoln, Reliance, Westinghouse, U.S.

2.18 SEISMIC RESTRAINTS

A. All Division 15 equipment, piping, and ductwork shall be anchored and seismically restrained as required by the UBC for Seismic Zone 3, NFPA 90A (current edition), UL Standard 181, Tri-services Manual and the SMACNA Guidelines for seismic restraints of mechanical systems.

B. The Division 15 contractor shall be responsible for supplying and installing equipment, vibration isolators, flexible connections, rigid steel frames, anchors, inserts, hangers and attachments, supports, seismic snubbers and bracing to comply with Seismic Zone 3 of the Uniform Building Code.

C. All supports, hangers, bases, anchorage and bracing for all isolated equipment shall be designed by a professional engineer employed by the restraint manufacturer, qualified with seismic experience in bracing for mechanical equipment.

D. Shop drawings submitted for earthquake bracing and anchors shall bear the Engineer's signed professional seal.

E. The above qualified seismic engineer shall determine specific requirements on equipment anchorage and restraints, locations and sizes based on shop drawings for the mechanical equipment which have been submitted, reviewed and accepted by the Architect for this project.

F. The Division 15 contractor shall require all equipment suppliers to furnish

equipment that meets the seismic code, with bases designed to receive seismic bracing and/or anchorage. All isolated mechanical equipment bracing to be used in the project shall be designed for the equipment shop drawings and certified correct by the equipment manufacturer for Seismic Zone 3 with direct anchorage capability.

G. Submit shop drawings, calculations, and printed data for the following items under provisions of the General Conditions of the Contract:

1. Complete engineering calculations and shop drawings for all vibration and seismic requirements for all equipment to be isolated and restrained.

2. The professional seal of the engineer who is responsible for the design of the Vibration and Seismic restraint System for isolated equipment.

3. Details for all the isolators and seismic bracing with snubbers proposed for items in this specification and on the drawings.

4. Details for steel frames, concrete inertia bases, and anchors to be used in conjunction with the isolation of the items in this specification and drawings.

5. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing anchors and snubbers.

6. The location of all restraints of pipes and ducts with the locations shown on a floor plan noting the size and type of anchorage and restraint to be used.

H. Snubbers:

1. Snubbers shall be double acting and consist of interlocking steel members restrained by replaceable shock absorbant elastomeric materials a minimum of 3/4 inch thick.

2. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch nor more than 1/4 inch.

3. A one "g" minimum vertical and lateral level shall be used in the design of all snubbers restraining isolated equipment.

I. Design and Installation

1. General: All mechanical equipment, piping and ductwork shall be braced, anchored, snubbed or supported to withstand seismic disturbances and remain operational. Provide all engineering, labor, materials and equipment for protection against seismic disturbances as specified herein.

2. All equipment not anchored directly to the floors shall be restrained by

cables as designed and furnished by the Restraint Manufacturer.

3. Isolated Equipment:

   a. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. Snubbers shall be installed with factory set clearances.

   b. Piping: All isolated and non-isolated piping 2-1/2" I.D. and larger shall be protected in all planes by restraints to accommodate thermal movement as well as restrain seismic motion. Where necessary the piping restraints shall be resiliently attached to the piping with vibration dampening inserts to prevent the transmission of vibration to the building structure. Locations shall be as scheduled and shall include but not be limited to:

      At all drops to equipment and at flexible connections.
      At all 45 deg. or greater changes in direction of pipe.
      At horizontal runs of pipe, not to exceed 30 ft. O.C. spacing.
      Piping shall be restrained by a cable restraining system using a minimum of two cables at all restraint points.

   c. Piping in mechanical rooms shall have additional restraints as scheduled.

4. Non-Isolated Equipment:

   a. The restraint systems for all non-isolated equipment are to be installed to resist stresses produced by lateral forces according to the International Building Code with an Occupancy Importance Factor of 1.5, a Seismic Zone Factor of Z = 0.75 for Zone 3 and a Horizontal Force Factor for Elements of Structures and Nonstructural Components of Cp = 0.3. In addition, the vertical forces restraint requirement shall be half the value of the horizontal forces. All equipment not anchored directly to floors shall be restrained by cables as designed and furnished by the Restraint Manufacturer.

   b. Acceptable Manufacturers and Suppliers for Non-Isolated Systems:
      1) Mason Industries, Inc.
      2) Korfund
      3) Amber/Booth Company

4) Vibration Mountings and Control Company

5. Manufacture and design of restraints and anchors for internally isolated equipment shall be the responsibility of the manufacturer of the vibration isolators furnished with the equipment.

6. Piping, ductwork, and equipment without moving parts shall be restrained as shown and noted on the drawings. Locations shown are approximate and shall be coordinated with other trades and with the structural engineer at the job site.

J. Field Services: The seismic restraint manufacturer's engineer shall inspect the final installation and shall certify that all seismic restraints have been installed per manufacturer's instructions and applicable codes and standards.

2.19 CHEMICAL CLEANING

A. Prior to operating any heating or cooling systems, all piping systems and components shall be chemically cleaned and flushed by an experienced chemical cleaning service approved by the Engineer.

B. Pipe Exterior: Wash and wipe pipe exterior to remove construction dirt, loose scale and flux.

C. Pipe Interior: Flush pipe interior with clean water. Continue flushing until the piping system runs clean. After flushing inspect strainer screens, refrigeration machine water boxes, piping low points, and tank drains to determine the presence of construction debris. If debris is found, disassemble equipment and remove debris. Reflush the system and re-inspect.

D. Do not operate centrifugal pumps until system has been cleaned and flushed.

2.20 GLYCOL FILL

A. This contractor shall furnish all propylene glycol solution for the chilled and heating water system to provide a 30% volumetric concentration. Glycol solution shall be similar to Dowfrost HD low toxicity polypropylene with extra strength corrosion inhibitors or equal of Jeffcool polypropylene glycol. This contractor shall provide 100 gallons of full strength glycol solution in addition to the 30% solution initial fill, for use in maintaining the system.

2.21 GREASING AND OILING

A. Prior to placing the equipment in operation, the bearings on all motors, fans, pumps, etc., shall be properly lubricated with a lubricant suitable for the service.

B. Lubrication instruction tags are to be left on "all" bearings and equipment for the

Owner's future use. Only lubricants recommended by the equipment manufacturers shall be used.

C. It shall be incumbent on the contractor to operate the building equipment used for temporary heat, etc., in a prudent manner to insure that when the building is turned over to the Owner all equipment is in a "first-class" condition.

D. Equipment shall not be operated unless:

1. All safety devices are installed and functioning properly.
2. Filters are in place on fan systems. Filters to be new and clean.
3. Equipment is properly greased and oiled.
4. Belts and drives are properly aligned and adjusted.

E. The contractor shall maintain a current "equipment maintenance" chart in the construction shack at all times. This chart shall be posted in a conspicuous place and shall include all items of maintenance necessary for proper operation of the equipment.

F. Equipment used for temporary heat and cooling shall, if requested by the Contracting officer, have tube bundles pulled by contractor for Owner inspection prior to acceptance.

2.22 VALVE TAGGING

A. All valves shall be designated by distinquishing numbers and letters on required charts and diagrams. The contractor shall furnish and install approved brass tags for all designated items, which numbers and letters on the tags corresponding to those on the charts and diagrams.

B. Brass tags shall be not less than 1-1/2" diameter with depressed black filled numbers not less than 1/2" high and black filled letters not less than 1/4" high. Tags shall be securely fastened to valves with approved brass "S" hooks, or brass jack chain, in a manner to permit easy reading. Zips ties are not acceptable. Do not attach to valve wheel. Brass tags shall be as manufactured by Seton Name Plate Company, New Haven, Connecticut, or approved equal.

C. Each valve shall have an identifying number identifying the unit. Standard identifications may be used for identifying type of service or fluid in pipe. The contractor shall submit his system of identification to the Architect for approval prior to ordering. Any work done without this approval is done at the contractor's risk.

D. Charts of all valves shall be furnished to the Architect by the contractor.

E. A chart to be mounted in a frame with clear glass front, and secured on the wall in the main Mechanical Equipment Room.

F. Second chart shall be prepared for use outside of the equipment room, and to be provided with an approved heavy transparent plastic closure for permanent protection. Two (2) holes to be punched at top of plastic closure to allow for affixing approximately an 8" length of nickel plated bead chain. Each hole to be reinforced by means of a small brass or nickel grommet. Plastic closure shall be as manufactured by Seton Name Plate Company, New Haven, Conn., or approved equal.

G. Identify all valves. A sample identification shall be as follows:

VALVE IDENTIFICATION CHART

NUMBER	DESCRIPTION	LOCATION	NORMAL POSITION
1.	Cold Water Supply to Water Heater	Mech. Room #121	Open
2.	Cold Water Supply to Hose	Room #13	Open
3.	Cold Water Supply to Equip. in Room #12	Room #18	Open
4.	Hot Water Supply to Toilet Room #212	Chase #210	Open
5.	Air Vents - Cooling Coil #12 (2 required)	Fan Room 3122	Closed
6.	Heating Hot Water Balancing Valve (Southwest Zone)	Above Ceiling Room #412	Marked On Valve

H. The above room numbers shall be the room numbers actually used.

I. Mechanical Equipment & Ductwork:

1. All mechanical equipment, including meters, fans, pumps, and other devices shall be identified with signs made of laminated plastic 1/8" or larger engraved letters. Signs shall be securely attached by rustproof screws or some other permanent means (no adhesives).

2. Information on sign shall include name of equipment, rating, maintenance instructions, and any other important data not included on factory attached nameplate.

3. Signs shall be attached to equipment so they can be easily read.

4. Identify all ducts exposed in mechanical equipment rooms and in ducts and pipe chases. Sample duct identification shall be as follows:

"Cold Duct - High Pressure - To Second Floor System"
"Exhaust Duct - Toilet Room - To EF-3"
"Ventilation Air Duct - To Utility Room #228"

5. Ducts shall be labeled at all wall penetrations and at connections to equipment.

2.23 PAINTING

A. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

B. Mechanical Contractor: Spot painting for application of pipe and equipment identification markers.

2.24 Coding, Pipe Identification & Painting:

A. All pipes are to be labeled and color coded with contents clearly identified and arrows indicating direction of flow.

1. Pipes shall be identified at the following locations:

a. Adjacent to each valve.
b. At every point of entry and exit where piping passes thru wall or floor.
c. Every 50 feet on long continuous lines.
d. On each riser and junction.
e. Adjacent to all special fittings or devices (regulating valves, etc.)
f. Connection to equipment.
g. Entire solar systems and all fill points.

2. Apply markers to they can be read from floor.

3. Labels and markers shall be of the self-sticking, all temperature permanent type as manufactured by W. H. Brady Co., 727 West Glendale Avenue, Milwaukee, Wisconsin, or Seton Name Plate Corp., 592 Boulevard, New Haven, Connecticut.

4. Pipe color coding shall be uniform throughout.

5. Background colors shall be as follows:

Yellow: Dangerous Materials (natural gas condensate, etc.)
Bright Blue: Protective Materials (filtered water)

Green: Safe Materials (chilled water, cold water, instrument air, sanitary sewer, etc.)

6. Letters of identification legend shall be 2" high for pipes 3" and larger, and 1" high for pipes 2-1/2" and under.

7. Markers shall be installed in strict accordance with the manufacturers instructions.

8. On chalky and loose insulation, soft, porous, fiber-filled or fiberglass coverings, a spiral wrap of pipe banding tape shall be made around the circumference of the pipe. Sufficient spiral wraps shall be made to accommodate the horizontal dimension of the pipe marker.

9. On bare pipes, painted pipes, and pipes insulated with a firm covering, pipe banding tape matching the background color of the marker shall be used for 360 deg. color coding. After applying pipe markers, wrap pipe banding tape around pipe at each end of marker. Tape should cover 1/4" to 1/2" of each end of marker, and should overlap approximately 1/2" to 1" on itself. Be sure pipe surface is dry and free of dirt or grease before applying markers or banding tape.

10. Stenciling may be used in lieu of the above labels and markers if finished application gives the same overall appearance, that is that stenciling is applied over a background color. If stenciling is used, letter heights, background colors, banding, and arrow shall be as specified above. Submit sample to Architect before proceeding with work.

2.25 PLASTIC MARKING TAPE

A. Provide and install a continuous plastic tape over the top of all underground utilities. Tape shall be placed 1/2 way between finished grade and top of utility line.

B. Plastic marking tape for underground utilities shall be acid and alkali-resistant Polyethylene film, 6 inches wide with minimum thickness of 0.004 inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in Table 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1 - TAPE COLOR

Yellow	Gas, Oil, Dangerous Materials
Blue	Water systems
Green	Sewer Systems

2.26 CEILING MARKERS

A. Use Brade valve finder ceiling tacks on all accessible ceiling tile to indicate location of valves and dampers.

B. Color code as follows:

Yellow	HVAC
Green	Plumbing
Blue	Air
White	Duct valves
Orange	Electrical devices
Red	Fire

PART 3 - EXECUTION

3.1 COORDINATION

A. All equipment and piping shall be arranged to allow for easy maintenance and access to service valves.

B. Provide valves and unions or flanges at all pieces of equipment to allow maintenance.

C. Install all automatic valves, sensor well, flow switches, etc., as directed by the control contractor.

3.2 TESTING

A. All piping shall be tested in accordance with Section 15042 prior to applying insulation or concealing in partitions, wall, etc.

3.3 ACCESS

A. All valves and equipment shall be located to allow easy access for inspection, service and maintenance, test and balance, and operation. If valves are installed in inaccessible locations it shall be this contractor's responsibility to furnish and install access doors of a type specified in Division 8 Section "Access Doors and Frames."

B. Locate piping, valves, etc., to allow easy access to and maintenance of equipment. Do not block walkways, filter access, maintenance access, or tube-pull space in equipment rooms.

3.4 LOCATIONS & ARRANGEMENTS

A. All pressure gages shall be so installed as to be easily readable from an eye level 5' -6" above the floor.

B. Test plugs on flow measuring stations shall be unobstructed, and shall be arranged in the piping per manufacturer's recommendations.

C. All equipment and accessories shall be installed to facilitate proper service and maintenance in compliance with the manufacturer's recommendations.

3.5 WIRING BY THE ELECTRICAL CONTRACTOR

A. It is the intent of these specifications that all line voltage electrical power wiring and power connections to equipment be furnished and installed by the electrical contractor, unless otherwise specified or shown on the drawings.

B. The mechanical contractor shall coordinate actual job-site power requirements with the electrical contractor prior to installation of power wiring and electrical equipment.

C. The electrical contractor shall provide necessary wiring to electric heat tape as required, and shall coordinate with the mechanical contractor the location and capacity of required circuits.

D. When mechanical system components are furnished with remote mounted control panels, alarm bells, alternators, etc. the electrical contractor shall run all required line voltage power wiring as directed by the mechanical contractor. It shall be the mechanical contractor's responsibility to coordinate the work and provide the necessary wiring diagrams.

E. When exhaust fans are provided which are not controlled by the ATC contractor, they shall be wired to local line voltage wall switches. The wall switch locations shall be coordinated with the Architect.

F. Line and low voltage control wiring will be furnished and installed by the ATC contractor in accordance with NEC and Division 16.

3.6 STORAGE AND INSTALLATION OF MOTORS

A. Handle motors carefully to prevent damage, denting and scoring. Do not install damaged motors or components; replace with new.

B. Store motors and components in a clean, dry place. Protect from weather, dirt, water, construction debris, and physical damage.

C. Install motors where indicated on the drawings and in accordance with

manufacturer's drawings and in accordance with manufacturer's published installation instructions.

D. Install each direct-connected motor such that it is securely mounted in accurate alignment. The drive must be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures. Provide each belt-connected motor with a securely mounted adjustable base to permit installation and adjustment of belts.

3.7 INSTALLATION OF ABOVE GROUND PIPING

A. Provide piping systems of sizes indicated on the drawings. Systems shall be installed complete.

B. Install piping systems in conformance with ANSI B31.

C. Install piping to allow for expansion and contraction of the piping systems. Provide offsets and swing joint connections at coils, pumps and other equipment to eliminate undue strain to the equipment connections.

1. Connect flanges and tack weld piping systems in place before full circumferential welds are made.
2. Springing of piping at equipment connections will not be permitted.
3. The use of "cold-spring" is not permitted.

D. Branch connections to up feed systems shall be made at the top or at a 45 degree angle above the centerline. Branch connections for down feed systems shall be made at the bottom or at a 45 degree angle below the centerline.

E. Install water piping with a pitch or slope of not less than 1-inch in 40 feet.

1. Provide 3/4-inch diameter plugged drain valves at each low point in mechanical rooms.

F. High Points: At each high point of the piping system provide a 3/8-inch diameter plugged globe valve.

1. Where high points are located in an inaccessible position, provide a 3/8-inch diameter bleed line from the high point of the piping system and extend to an approved location, with access. Anchor bleed piping and provide 3/8-inch diameter globe valve.

G. Support, anchor, and guide piping systems to preserve piping flexibility and the isolation effects of sound and vibration isolation hangers.

H. Conform to the welding and welder qualification requirements paragraph of this Section.

1. Perform welding in conformance with ANSI B31.1.
2. Perform welding in ambient temperatures above 0 degrees F.
3. Ream and clean ends of piping.
4. Support piping, align and tack weld making allowance for pipe pitch and insulation. Temporarily block piping at hangers.
5. Use welding pipe clamps on piping 4-inch diameter and larger, and verify alignment before welding.

I. All installed pipe lines shall be straight, free from dents, scars and burrs, with ends reamed smooth and shall remain straight against strains tending to cause distortion during system operation. The Contractor shall make proper allowance for pipe line expansion and contraction so that no unsightly distortion, noise, damage or improper operation will occur.

J. Piping shall be run in a neat and efficient manner and shall be neatly organized. Piping shall be run parallel or at right angles to the building walls or construction. The Contractor shall study the general, electrical, and other drawings to eliminate conflict of piping with structure, sheet metal, lighting, or other services. Unless specified otherwise, no piping shall be exposed in a finished room, all changes in direction shall be made with fittings.

K. All piping shall be clean and free from acids and loose dirt when installed.

L. Temporary pipe plugs of rags, wool, cottons, waste or similar materials shall not be used.

M. All piping shall be so arranged to not interfere with removal of other equipment or devices and shall not block access openings, etc.

N. Piping shall be arranged to facilitate equipment maintenance.

O. Flanges or unions shall be provided in the piping at connections to all items of equipment.

P. All piping shall be so installed to insure noiseless circulation.

Q. All valves and specialties shall be so placed to permit easy operation and access, and all valves shall be regulated and adjusted at the completion of the work.

3.8 JOINTS AND CONNECTIONS

A. Mechanical Grooved Pipe Couplings:

1. Pipe shall be prepared in accordance with the latest edition of the manufacturer's published standard, ANSI/AWWA C-606, UL, FM, NFPA, or other applicable standards.

2. Steel pipe shall be grooved in accordance with the manufacturer's standard specification. Standard weight pipe shall be roll grooved without metal removal or square cut grooved. Light wall pipe shall be roll grooved without metal removal.

3. Operating conditions shall not exceed temperature range of the gasket or valve lining selected and working pressures shown int he coupling manufacturer's current product specifications.

4. Hole cut pipe shall have a machine cut hole at a predetermined position, on the centerline of the pipe, of a size to receive the housing locating collar, in accordance with the manufacturer's published instructions.

5. Couplings, fittings, valves, and pipe shall be assembled in accordance with the manufacturer's latest published instructions.

6. Pipe shall be checked to be certain it is sufficiently free of indentations, projections, grooves, weld seams or roll marks on the exterior of the pipe over the gasket seating area to assure a leak tight seat for the gasket, that pipe ends are square cut and that end preparation is in accordance with manufacturer's published standards.

7. Gasket style and elastomeric material (grade) shall be checked to be certain gasket supplied is suited to the intended service.

8. Thoroughly lubricate the gasket exterior including the lips and/or pipe ends and housing interiors. Lubricant shall be approved by the gasket manufacturer.

9. No pipe length shall be left unsupported between any two couplings.

3.9 GROOVED PIPE SPECIALTIES INSTALLATION

A. All pipe specialties in a grooved pipe system shall be installed in accordance with the manufacturer's published instruction.

B. Strainers shall be installed on the inlet side of all circulating pumps and automatic control valves and as shown on the drawings.

C. Suction diffusers shall be installed at the inlet of all floor mounted circulating pumps.

D. Dielectric waterways shall be installed between all dissimilar metal pipes.

E. Before piping system has been tested and again before the piping system has been put into service, inspect screens in each strainer and suction diffuser. Clean

all dirty screens.

F. After piping system has been put into service and run for approximately 200 hours, reinspect all screens in strainers and suction diffuser and remove start-up screen in suction diffuser.

G. Venturis flow sensors on all sizes shall be installed with a minimum straight pipe requirement of 5 diameters upstream and 2 downstream. Orifice/indicators flow meters for sizes 2-1/2" to 4" have a minimum straight pipe requirement of 5 diameters upstream and 2 downstream. For sizes 5" and up the straight pipe requirement is 10 diameters upstream and 4 downstream.

3.10 VALVE INSTALLATION

A. After piping system has been tested and put into service, but before final testing, adjusting and balance, inspect each valve for possible leak. Open and close each valve to verify proper operation.

3.11 INSTALLATION OF UNDERGROUND PIPING

A. Coordinate the routing and location of all underground piping with building footings. See structural drawings.

B. Outside pipe placed underground shall be buried deep enough to protect against freezing.

C. Depth of bury of services shall be:

	Minimum	Preferred
Sewer	30"	36"
Rainwater	30"	36"
Water	42"	48"

D. Services shall be buried at the "preferred" depth unless site conditions require the "minimum" depth as listed above.

E. Handling: Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean

during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the owner. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place.

F. Coated and wrapped steel pipe shall be handled in conformance with AWWA Standard C203.

G. Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contractor Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutters shall be used when practicable.

H. Copper tubing shall be cut square and all burrs shall be removed.

I. Locating: Where the location of the water pipe is not clearly defined by dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall, in all cases, cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

J. Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

K. Copper tubing shall not be installed in the same trench with ferrous piping materials.

L. Nonferrous metallic pipe: Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches must be maintained between pipes.

M. Plastic pipe shall be insulated against heat from water lines, or other heat sources.

N. Placing and Laying: Pipe and accessories shall be carefully lowered into the trench. Under no circumstances shall any of the materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon a compacted sand bed, with recessed excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in

water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until jointing is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as required.

O. Where prescribed by the manufacturer of the pipe, gaskets shall be placed in the groove on the end of the pipe before the pipe is placed in the trench. After the pipe has been forced together, the position of the rubber gasket shall be checked with a feeler gage in accordance with the pipe manufacturer's recommendations.

P. Pipe shall be protected during handling against impact shocks and free fall and the pipe interior shall be free of extraneous material.

Q. Laying of gravity drain shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the pipe has a uniform invert. As the work progresses, the interior of the pipe shall be cleared of all superfluous materials.

R. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints in gravity drain lines shall then be placed, fitted, joined, and adjusted so as to obtain the degree of water tightness required.

3.12 EXCAVATION & BACKFILLING (also refer to Division 2)

A. Excavate as shown on drawings allowing ample space for construction, gravell fill, etc.

B. Removal and redeposit: All excess earth which is surplus after construction of all backfill shall be loaded and transported off the site and disposed of properly.

C. Protection: This contractor shall take all necessary precautions to protect public and private property adjacent to the site. He shall provide all barriacades, signs, warning devices, etc., as required.

D. Backfill: All backfill can possibly be on-site material free of vegetable matter and other deleterious substances and shall not contain rocks or lumps greater than 4” in maximum dimensions. In all utility trenches, backfill shall allow for 6” of clean sand below and 12” of clean sand above all piping.

E. Compaction shall be completed to match existing ground conditions adjacent to

utility trenches. Depressions from settling shall be unacceptable.

3.13 REFRIGERATION PIPING INSTALLATION

A. Refrigeration tubing shall be cut (with a pipe cutter) so ends are perfectly square and will "bottom" in fittings. There must be no gaps left thru which solder can run into the line. If a hack saw must be used, it shall always be guided with a mitre box to insure a square, even cut. Tubing shall be reamed to remove burrs, being careful not to expand tubing while reaming.

B. The outside of the copper pipe and the inside of the fittings, where solder will be applied, shall be burnished. Fine crocus cloth or fitting brushes especially made for this type of work should be used. Surfaces shall be burnished until all dirt and oxide is removed. Cleaned surface should not be touched with hands or gloves.

C. A light coat of brazing flux shall be applied to both pipe and fittings. Acid flux (such as muriatic or hydrochloric acid) shall not be used. The resulting corrosion would seriously affect the pipe and composition for brazing.

D. Joint shall be heated to proper brazing temperature, being sure that it is uniformly hot so brazing material will flow to all parts of the joint. The brazing material shall be fed to the joint until a uniform line of brazing material appears around the pipe at the end of the fittings.

E. Refrigerant piping shall be joined with "sil-fos" soldered joints. "Easy-Flow" solder may be used for connections at valves and specialties only.

F. An oxy-acetylene torch shall be used for heating the joint for brazing. During brazing, the pipe and fittings must be kept full of an inert gas, N or CO2 to prevent formation of scale.

NOTE: Should the contractor be observed by the job superintendent or any authorized inspector soldering or brazing any part of a refrigeration piping system without proper circulation of inert gas thru the lines being worked on, it shall be assumed that the entire system was fabricated in such a manner, and all of the piping installed on that system shall be condemned and promptly removed from the job site at the expense of the contractor.

G. When solenoid stop valves are being installed, the coil shall be removed to prevent the heat of soldering from ruining the insulation. When sight glasses are being installed, the glass should be removed to prevent cracking. No heat shall be applied near the bulb of the expansion valve or any other place where an excessive temperature may cause damage.

H. All of the foregoing piping shall be examined, and if found to leak, shall be made tight and test repeated until the system is proved tight. All tests shall be verified by the Architect.

I. After all refrigeration piping and connections are completed, make a leak test by filling the system with freon and test for leaks with an electronic leak detector. Evacuate all piping to 500 microns and hold for 24 hours prior to final charging.

J. Charge the system with clean, dry refrigerant until a proper operating charge has been added as determined by proper operation with a clean refrigerant stream at the sight of glass.

K. Pipe covering shall not be installed, nor the piping anchored until testing is completed and all leaks have been properly eliminated.

3.14 INSTALLATION OF THERMOMETERS AND THERMOMETER WELLS

A. General: Install thermometers and thermometer wells at locations shown on the drawings and where specified. Install thermometers so that they can be read by a person standing on the floor and with normal illumination.

B. Locations: Install thermometers and thermometer wells at the following locations, and elsewhere as indicated.

1. At the inlet and the outlet of each hydronic zone.
2. At the inlet and the outlet of each hydronic boiler and chiller.
3. At the inlet and the outlet of each hydronic coil in air handling units.
4. At the inlet and the outlet of each hydronic heat exchanger.
5. At the inlet and the outlet of each hydronic heat recovery unit.
6. Thermometer Wells: Drill and tap pipes 5-inch and larger for installation of wells. Provide tees or reinforced welding fittings on pipes smaller than 5-inch for installation of wells. Provide oversize tees or enlarge pipe smaller than 3-inch at points where wells are installed to avoid restriction of flow.

3.15 INSTALLATION OF PRESSURE GAUGES

A. General: Install pressure gauges at locations shown on the drawing and where specified.

B. Locations: Install pressure gauges in the following locations, and elsewhere as indicated.

1. At the suction and the discharge of each pump.
2. At the discharge of each pressure reducing valve.
3. At the water service outlet.
4. At the inlet and the outlet of air cooled chillers.

C. Pressure Gauge Cocks: Provide stem mounted pressure gauges with T-handle cocks and pressure snubbers.

3.16 INSTALLATION OF FLOW METERS

A. General: Install flow meters at locations shown on the drawings and where specified. Install in accordance with ASME recommendations for flow meters.

B. Locations: Install flow meters in the following locations, and elsewhere as indicated.

1. At the discharge of each pump.
2. At the inlet of each hydronic coil in built-up central systems.

C. Piping: Install piping in the exact locations and arrangement, both upstream and downstream of primary elements, as required by the manufacturer's published literature. Provide any necessary piping changes required for certification without additional cost.

D. Horizontal Pipe: Provide the connection nipples at, or slightly above, the horizontal centerline of the pipe to minimize the entrance of gases and impurities when flow is measured in horizontal pipe.

E. Taps: Provide taps with shut-off valves and quick connecting hose fittings for portable meters or double-ferrule compression fittings for connection to tubing for permanently located meters or recorders.

F. Portable Flow Meter Connections: Install connections for attachment to portable flow meter hoses that are readily accessible.

END OF SECTION 15050.

SECTION 15180 - INSULATION

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 WORK INCLUDED

A. It is the intent of this section of the specifications that all hot (above 105° F.) and cold (below 55° F) surfaces of all piping and mechanical system components be insulated, unless specifically excluded herein.

B. Systems to be insulated:

l. Supply air ductwork
2. Culinary hot and cold water piping systems
3. Heating hot water piping systems
4. Chilled water piping systems
5. Refrigerant suction piping systems.
6. Roof drain piping systems
7. Hot water and waste lines below handicapped lavatories.

C. The providing of all materials, supplies, equipment, tools, transportation, and facilities and performing all labor and service necessary to provide the work outlined above and as shown on the working drawings.

PART 2 - PRODUCTS

2.1 COMPLIANCE

A. All insulation shall (as a minimum) conform to the requirements of the building code an have a flame spread rating of less than 25 and smoke developed less than 50.

B. Insulation shall be as manufactured by Johns-Manville, Owens-Corning, Knauf, Armstrong, or Certainteed.

2.2 HOT & CHILLED WATER PIPING, DOMESTIC HOT & COLD WATER PIPING

A. All piping shall be insulated with 2-piece heavy density pipe insulation having an

average thermal resistivity in the range of 4.0 to 4.6 Hr Deg. F. Ft2/BTU per inch of thickness on a flat surface at a mean temperature of 75 deg. F. Thickness of insulation shall be as follows:

MINIMUM PIPE INSULATION

INSULATION THICKNESS IN INCHES FOR PIPE SIZES**

PIPING SYSTEM TYPES	FLUID TEMP. RANGE, F	RUN-OUTS 2"*	1" & LESS	1-1/4" TO 2"	2-1/2" TO 4"	5" TO 6"	8" +
HEATING SYSTEMS							
Low press/temp	201-250	1	1-1/2	1-1/2	2	2	2
Low Temp.	120-200	1/2	1	1	1-1/2	1-1/2	1-1/2
COOLING SYSTEMS							
Chilled water	40-55	1/2	1/2	3/4	1	1	1

* Runouts not exceeding 12 feet in length to individual terminal units.
** For piping exposed to outdoor air, increase thickness by 1/2".

B. Pipe insulation shall be covered with an all-service jacket.

2.3 ROOF DRAIN PIPING

A. Roof drain receivers and roof drain piping (both primary and secondary) except in masonry wall and where buried in the ground, shall be insulated as specified for domestic cold water. Insulation thickness shall be 1".

B. Roof drain piping and fittings running exposed in cafeteria area shall be covered with a white PVC cover.

2.4 Not used.

2.5 Not used.

2.6 REFRIGERANT SUCTION PIPING

A. Refrigerant suction piping shall be insulated with 1/2" thick closed cell flexible foam. Finish with two heavy coats of grey sealer.

2.7 HOT WATER & WASTE PIPING EXPOSED BELOW HANDICAPPED LAVATORIES

A. Insulate all exposed surfaces with an approved ADA insulation kit as required by sink manufacturer.

2.8 Not used.

2.9 MEDIUM PRESSURE DUCTS

A. Medium pressure ducts shall be externally insulated with 1" thick 1.5 lb. density mineral fiberglass insulation. Insulation shall be furnished with an integral FSK vapor barrier jacket. Insulation shall be applied with edges tightly butted and secured by impaling on pins welded to the duct or on metal clips, previously adhered to the ducts with manufacturer's adhesive. Pins or clips shall be spaced to hold insulated firmly against the duct surface. Where required, insulation on the underside of all horizontal ducts and sloping ducts shall be additionally secured by applying an adhesive. All penetrations shall be sealed with vapor barrier adhesive. All seams shall be covered with 2" wide strips of same insulation facing material adhered with adhesive.

2.10 MEDIUM PRESSURE FLEXIBLE DUCT

A. Flexible supply air ducts shall be insulated with 1" thick 1.5# density duct wrap with vapor barrier. Insulation shall comply with UMC Standard 10-1.

2.11 LOW PRESSURE ROUND DUCTS

A. All round metal ducts shall be wrapped with 1" thick fiberglass duct wrap with factory-applied vapor barrier. All joints shall be sealed with mastic and taped to form a neat and complete insulation system.

PART 3 - EXECUTION

3.1 GENERAL

A. The contractor shall provide a complete installation which is neat in appearance and functional.

B. Remove all excess materials and packaging from job site.

C. All insulation shall be continuous thru wall and ceiling openings and thru sleeves.

D. Insulation on all cold surfaces where vapor barrier jackets are used will be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.

E. Valves and fittings inside the building shall be insulated as specified for the piping

systems and covered with high temperature P.V.C. insulation fitting covers.

F. Fittings and valves for pipe size smaller than 4" shall be insulated and finished with Insulating and Finishing Cement to a thickness equal to the adjoining pipe insulation. Fittings and valves for pipe sizes 4" and larger shall be insulated with segments of the molded insulation secured with No. 20 gage galvanized annealed steel wire finished with a smoothing coat of finishing cement. Vapor seal with a layer of glass fabric embedded between two 1/16" coats of vapor seal adhesive. Lap seal outer jacket at least 1" on itself adjoining insulation.

G. In exposed areas, all fittings shall be additionally finished with FSK wrap smoothly adhered. Overlap the FSK wrap on itself and adjoining pipe insulation. Overlap to be at least 1" on pipe insulation below 4" and 2" on sizes 4" and above.

H. Insulation inserts and shields for cold surface piping such as roof drain lines and domestic cold water piping shall be installed at all pipe hangers. Inserts between the pipe and pipe hangers shall consist of calcium silicate block 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:

1/2" to 2-1/2" pipe size	6" long
3" to 6" pipe size	9" long
8" to 10" pipe size	12" long

I. Rigid metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and length specified for the insulation hanger inserts.

J. Vapor barrier wrap shall be sealed tight and not penetrated by the hanger or shield.

K. Block insulation shall be applied with edges tightly butted, joints broken, and secured with No. 16 gauge galvanized annealed steel wire or 1/2" x .015" galvanized steel bands on 12" maximum centers for large areas. Where required, welded studs, clips, or angles shall be provided as anchored for fire and bands. Finish shall be Insulating and Finishing Cement applied 1/4" thick in one coat, trowelled to a smooth finish. Over the Insulating and Finishing Cement an FSK outer jacket cloth shall be smoothly adhered with vapor barrier adhesive.

L. Insulation blocks shall be applied with edges tightly butted, joints broken, and secured with No. 14 gauge galvanized annealed steel wire, or 1/2" X 0.15" galvanized steel bands on 12" maximum centers for large areas. Where required, welded studs, clips, or angles shall be provided as anchored for wires and bands.

M. Over the insulation, 1" hexagonal mesh wire shall be tightly stretched in place and secured by wiring to anchors, with edges tied together. Finish shall be Johns-

Manville No. 3011 Insulating and Finishing Cement or approved equal applied 1/4" thick in one coat, trowelled to a smooth finish.

N. Over the Insulating and Finishing Cement, pre-sized glass cloth shall be smoothly adhered with Adhesive.

O. Adhesives, mastics, and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon.

P. Where insulation pipes pass thru sound or fire-rated walls, floors, or ceilings, the insulation sleeves shall be sound or fire-rated to match rating of surface penetrated.

Q. All insulation which runs outside of the building, or inside of the building in areas where the insulation will be exposed to physical abuse, shall be jacketed with a minimum thickness of .016 inch aluminum. The insulation and aluminum shall be secured in place by a continuous friction type joint to provide a positive weatherproof seal along the entire length of the aluminum jacket. Then, an aluminum preformed strap containing a permanently plastic weatherproof sealant shall be centered over each circumferential joint, and secured by tightening on a clip, or by use of separate 1/2 inch wide stainless steel banding. All elbows, tube, turns, sweeps, and bends shall be insulated with mitered sections of aluminum-jacketed insulation. Joints shall be sealed with a sealing compound and preformed aluminum bands. Valves shall be covered by prefabricated sections of aluminum-jacketed insulation according to manufacturer's recommendation.

R. Insulation at flanged ends of heat exchangers shall be applied so that these items can be removed without damaging the insulation.

3.2 INSULATION WORKMANSHIP

A. All insulation shall be applied by specialists experienced in the field, and shall be neat in appearance. Neatness in appearance shall be equated to proper insulation application procedures, and sloppy workmanship will not be tolerated. Work which is deemed unacceptable shall be condemned, removed, and replaced at the contractor's expense.

B. Protect floors, valve handles, accessories, etc., to keep paste off areas not being insulated.

C. Splitting of longitudinal sections on flexible foam pipe insulation will not be permitted.

D. Do not install insulation on pipes which require heat taping without coordinating with mechanical contractor.

3.3 CLEAN-UP

A. The piping shall be cleaned and tested prior to installation of insulation.

B. Fittings shall be cleaned after insulation is installed.

END OF SECTION 15180.

SECTION 15400 - PLUMBING

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 SCOPE OF WORK

A. Piping diagrams are schematic and indicate preferred pipe routing. It is the intent that the installation be complete. Where fixtures are not shown connected to any required services, they shall be connected properly and completely. Connect all fixtures to various services, i.e., hot water, cold water, waste, and vent, etc., as required.

B. The work shall include furnishing of all materials and labor required for the job as described, together with all accessories and trim implied or required to finish the work, and generally as follows:

1. Complete rain removal system, including piping and roof drains.
2. Plumbing fixtures and piping.
3. Condensate drain systems.
4. Sanitary sewer systems.

1.3 STANDARDS

A. Plumbing installation shall be made in accordance with the International Plumbing Code, City Code, and all other governing codes.

B. In the event drawings violate the codes as being locally enforced, the contractor shall base his estimate on the enforced code requirements.

1.3 DISINFECTING

A. After flushing the mains, introduce a water and chlorine solution concentrated to 100 PPM to disinfect the system and oxidize piping contaminates. Retain treated water and chlorine for a period of not less than three hours or more than six hours before final flushing out of system.

B. All valves should be opened periodically during the process and the residual chlorine checked to ensure that at least 50 percent of the initial concentration is present to complete the disinfection. If there is less than 50 percent, the valves

should be allowed to drain water until the 50 percent or greater level is obtained. A make-up chlorine solution of a concentration equal to the initial concentration must be added as needed during the withdrawal of the spent solution.

C. A warning sign shall be conspicuously posted at each water outlet and faucet during the disinfecting process to prevent occupants from drinking the water.

D. Flushing: Following disinfection, all treated water shall be flushed from the system through its extremities. Flushing shall continue until samples show that the quality of the water delivered is comparable with the quality of the public water supply and satisfactory to the public health authority having jurisdiction. Flushing shall be repeated if samples taken daily over a period of three days show the water quality is not being maintained. Samples shall be taken only from taps located and installed in such a manner that they will not contribute any contamination. Samples shall not be drawn from hydrants or through unsterilized hose. Test samples shall be certified by a recognized and approved testing laboratory, and a certificate of acceptability shall be submitted.

E. Written certification of the disinfecting process and purity of water samples shall be forwarded to the Owner's representative.

1.4 VERIFICATION OF GRADE

A. **The contractor shall verify the connection of water, and waste piping systems to the mains, and shall verify the actual job site elevation and location prior to the installation of the building footings.**

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Approved cleanouts shall be installed in the base of each vertical drainage line, and in the horizontal line at each change in direction. In addition, there shall be cleanouts spaced at a maximum of 50' in all horizontal lines. All cleanouts shall be extended to accessible surfaces.

2.2 WATER HAMMER

A. Provide and install stainless steel bellows type shock absorbers in the ends of all multiple fixture water lines and in piping ahead of snap-acting automatic valves.

B. Absorbers shall be sized and located in compliance with manufacturer's recommendations for the specific application. Absorbers shall be Zurn, Wade, or Smith.

C. Absorbers shall not be installed in inaccessible areas. Extend piping to accessible

locations.

2.3 FLASHINGS

A. All pipes passing thru the roof shall be neatly flashed. Flashing shall be provided under Division 7.

2.4 PLUMBING FIXTURES

A. This contractor shall furnish and install all fixtures shown on the architectural or mechanical drawings or specified hereinafter, clean and adjust all fixtures and replace any damaged fixtures at the contractor's expense.

B. The fixtures shall be all new and complete as shown and described in manufacturer's catalog, and as required for the work, including accessible loose key compression stops above the floor in supplies to all fixtures, and cast brass P-traps, unless otherwise shown. Trim for all fixtures shall be chrome-plated, and all trim shall match in design. Supply faucets shall have renewable seats and barrels. Fixtures shall be Kohler, American Standard, Crane, or approved equal.

PLUMBING FIXTURES

WC-1	Water Closet: American Standard 2257.103 syphon jet, wall hung, elongated bowl, 1-1/2" top spud; Flush valve: Sloan Royal 111 ES-S 1.6 gpf, flush mounted in wall, courtesy flush override button, include 120V transformer in each plumbing chase; K-666C 'Lustra' extra heavy solid plastic white open front seat with stainless steel check hinge; Wade W-311 (horizontal) or W-331 (vertical) series carrier, single or double right or left as required, with foot support.
WC-2 (Handicapped)	Water Closet: Same as "WC-1" - Set at handicapped height.
U-1 Urinal: (Handicapped)	American Standard 6561-017 vitreous china, wall hung, siphon jet with flushing rim, 2" outlet connection, 3/4" top spud; Flush valve: Sloan Royal 186-1 ES-S 1.0 gpf, flush mounted in wall, courtesy flush override button chrome plated flush valve; Plate type carrier and bearing plate - Wade W-452, Zurn 1222, or Smith 633.
L-1 Lavatory: (Handicapped)	American Standard 0355.012 vitreous china, front overflow, anti splash rim, center basin, wall hanger, punched for concealed arm carrier, Sloan EFT-600 (or

approved equal) automatic faucet with control module, solenoid tempering valve, hw & cw back checks, and one transformer per plumbing chase. Faucet to be installed to manufacturer's recommendation. Include grid strainer, tailpiece and flexible supplies with loose key stops and brass P-trap. Support lavatory with Zurn ZN1231 concealed arm carrier with foot support. Provide and install Trubro LavGuard insulation for supplies and drain.

SS-1 Service Sink: (Floor type) — American Standard Floorwell 7741.000 28" x 28" service sink, floor mounted, drain channels; Chicago Faucet No. 897 polished chrome faucet with vacuum breaker, hose end with hose, bucket hook, wall brace integral stops and rough chrome finish. Faucet to be mounted 30" above finish floor; K-8940 rim guard; K-9146 drain with strainer for 3" connection.

S-1 Sink: — Elkay LR-1716 17" x 16" x 7-1/2" deep sink, 18 ga. stainless steel, drilled for three hole 8" centerset faucet, self rimming, sound dampening, cup strainer, FAUCET: CHICAGO 1100-GN2AE3-317CP faucet with gooseneck spout, wrist blade handles, vandal resistant aerator, and flexible supplies. Brass p-trap.

EWC-1 Drinking Fountain: — Elkay EBFATL-8-SS electric water cooler. Bi-level, wheelchair access, double bowl, wall mounted, air cooled, refrigerated type, to cool 8 gal/hr. from 80 deg. F. to 50 deg. F. with 90 deg. F. EAT. 1/5 HP hermetic compressor, 120/1/60. 304 stainless steel top w/chrome plated bubbler and 'Light Touch' wrap around self-closing press bar operable from front of fountain. Stainless steel cabinet. Note: Cut electrical cord at time of installation to suit electrical outlet provided.

HB-1 Hose Bibb: — Chicago Faucet No. 952 (No. 998 where connected to exposed piping) 3/4" chrome plated hose bibb with No. 293-6 handle and 3/4" threaded outlet with integral vacuum breaker.

HB-2 Hose Bibb: — J. R. Smith 5509QT non-freeze anti-syphon wall hydrant with bronze casing and plain bronze face, provide with loose key and set screw for each hydrant.

FD-1 Floor Drain: — J. R. Smith 2005 or 2010 cast iron drain with nickel bronze top. Drain to have deep seal P-trap.

RD-1	Roof Drain:	Roof drains shall be cast iron type with flashing collar, C.I. dome, gravel guard, extension, sump receiver, and underdeck clamp. See plans for sizes. J. R. Smith #1010-ERC.
RD-2 (Secondary)	Roof Drain:	J. R. Smith #1080-ERC w/2" water dam, duco cast iron body with combined flashing clamp and gravel stop with underdeck clamp, extension, sump receiver, and cast iron dome. See plans for sizes.
DN-1	Downspout Nozzle:	Smith #1770 brass downspout nozzle. Provide 1/4" mesh aluminized, slipfit birdscreen. See plans for sizes.

2.5 LEAD PANS AND WATERPROOF MEMBRANES

A. Furnish a 30" square 4# lead flashing with each roof drain.

B. All floor drains shall be fitted with clamping collar and waterproof membrane.

C. Not used.

D. Care should be taken not to clog weep holes. All pans will be tested by placing test plug in drain and filling with water overnight.

2.6 CONDENSATE DRAIN

A. All refrigerated air conditioning which have cooling coil condensate drip pans with pipe connections shall be piped to the nearest drain by this contractor.

B. Pipe location and routing shall be approved by the Owner's representative.

C. Piping shall be the same size as the drain pan connection, and shall be trapped to prevent forced air flow thru the pipe.

2.7 VACUUM BREAKERS, DOUBLE CHECK VALVE ASSEMBLIES, & BACKFLOW PREVENTERS

A. Vacuum breakers and backflow preventers shall comply with requirements of the International Plumbing Code for the actual installed duty.

B. Vacuum breakers and backflow preventers shall be of the type, style, and arrangement approved by the Code.

C. All vacuum breakers and backflow preventers shall be installed with the necessary isolation valves and test cocks.

PART 3 - EXECUTION

3.1 PRODUCT HANDLING

A. Protection: Use all means necessary to protect plumbing materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

3.2 TESTING

A. Furnish all required personnel and equipment and make all tests required to receive the approval of the Owner and all agencies having jurisdiction.

3.3 CLEANING UP

A. Prior to acceptance of the building, thoroughly clean all exposed portions of the plumbing installation, removing all labels and all traces of foreign substance, using only a cleaning solution approved by the manufacturer of the plumbing item and being careful to avoid all damage to finished surfaces.

3.4 ROOF DRAIN LOCATIONS

A. This contractor shall review the architectural and structural drawings and shall field verify from actual job site conditions that the roof drains are located at the low points of the roof systems. Locations shown on the plumbing drawings are approximate. All low points on the roof shall have primary and secondary roof drains installed in them unless otherwise noted.

3.5 WATER CLOSET INSTALLATION

A. General: Install water closets as shown on the drawing and as follows:

1. Supply pipe extending from wall shall be covered by chrome plated sleeve and wall flange.
2. Additional wall plates shall be provided where each pipe extends through finished wall.
3. Two rubber or plastic seat bumpers with metal holders shall be provided and secured to the wainscot behind the fixture.
4. The centerline of the flush valve shall be on the centerline of the fixture, 39 inches above the finished floor and a minimum of 2-1/4 inches from the wall.
5. Chrome plated pipe support shall be provided on the long flush pipe outlet

and shall be secured rigidly to the wall with suitable anchors.

6. The backflow preventer for the flush valve shall be installed at the discharge of the valves.
7. The flush valve water piping concealed in the partition shall be rigidly supported; piping between flush valve and wall shall be provided with a factory fabricated chromium plated spacer sleeve and wall flange.
8. The automatic flush valve shall be flush mounted in the wall. Install automatic flush valve to manufacturers recommendations. One transformer shall serve up to ten flush valves.

3.6 LAVATORY INSTALLATION

A. General: Install lavatories as shown on the drawings and as follows:

1. Lavatories for use by wheelchair handicapped shall be installed with a maximum rim height of 34", a minimum vertical clearance of 29" from floor, and a minimum clear knee recess of 30" in width and 20" in depth.
2. Trap on lavatory for use by wheelchair handicapped shall be installed so as to provide maximum clearance under bowl. Exposed waste, trap and hot water supply under lavatory shall be insulated in accordance with the requirements for domestic hot water piping.
3. All lavatories shall be installed with a rim height of 34".
4. Automatic faucets shall be installed according to manufacturers recommendations. One transformer shall serve up to three faucets.

3.7 URINAL INSTALLATION

A. General: Install urinals as shown on the drawing and as follows:

1. Supply pipe extending from wall shall be covered by chrome plated sleeve and wall flange.
2. Additional wall plates shall be provided where each pipe extends through finished wall.
3. The centerline of the flush valve for wall hung urinals shall be on the centerline of the fixture, 45 inches above the finished floor and a minimum of 2-1/4 inches from the wall.
4. The centerline of the flush valve for handicap urinals shall be 40 inches or less above the finished floor.
5. The backflow preventer for flush valve shall be installed at the discharge of the valve.
6. The flush valve and the water piping concealed in the partition shall be rigidly supported; piping between flush valve and wall shall be provided with a factory fabricated chromium-plated spacer sleeve and wall flange.
7. The automatic flush valve shall be flush mounted in the wall. Install automatic flush valve to manufacturers recommendations. One transformer shall serve up to ten flush valves.

3.8 FIXTURE CONNECTIONS

A. Floor Mounted Water Closets and Service Sinks: Provide connections between soil pipes and floor connected water closets and service sinks made with cast-iron floor flanges.

B. Connection sizes shall be 4-inch for water closets and 3-inch for service sinks.

C. Floor flanges shall be slipped over the ends of the pipes and caulked in position.

D. Special short radius fittings shall be used where space does not permit the use of standard fittings below the flanges.

E. Setting Compounds and Gaskets: Provide watertight and gas tight seals between flanges and fixtures with plumbing-fixture-setting compound or manufacturer's standard non-asbestos gaskets.

F. Neither rubber gaskets nor putty shall be used in sealing connections.

3.9 FIXTURE SUPPORTS

A. Urinal Support: Provide urinal chair carriers consisting of a pair of cast-iron feet bolted to or imbedded into the floor together with 1.66-inch outside diameter (minimum), steel tubular upright members, steel hanger support plate, and steel bearing plate connected to cast iron or steel adjustment sleeves and furnished with necessary bolts, nuts, washers, and chrome plated trim. Provide chair carrier that is fully concealed in the building construction and that supports the fixture in such a manner that no part of the fixture will be supported by the wall or the partition.

B. Lavatory Support: Provide lavatory chair carriers consisting of a pair of cast-iron feet bolted to or imbedded into the floor together with 1.66- inch (minimum) steel tubular upright members, a horizontally adjustable alignment truss or tie rod at bottom and another at the top connected to cast-iron or steel adjustment sleeves and painted cast-iron or steel adjustment sleeves, and painted cast-iron concealed arms.

3.10 STRAINER INSTALLATION

A. General: Place strainers ahead of pressure reducing valves, automatic control valves, pumps, and elsewhere as indicated on the drawings or specified.

3.11 BACKFLOW PROTECTION VALVE INSTALLATION

A. General: The entire water distribution system shall be protected against contamination due to backflow from non-potable sources. Each connection to a

fixture or an item of equipment shall be protected in accordance with the requirements of the National Plumbing Code.

B. Reduced Pressure Zone Backflow Preventer: Install a reduced pressure zone backflow preventer in the building water supply main to expansion tanks, condenser water systems, and boilers as shown on the drawings and/or as required by the local codes.

3.12 INSTALLATION OF PIPE SLEEVES

A. Basic Requirements: Install pipe sleeves as follows:

1. Pipe sleeves shall be provided for all pipes passing through walls, slabs on grade and floors. Sleeves may be omitted where pipes pass through exterior walls above ground to lawn faucets, wall hydrants and downspout nozzles.
2. Sleeves for pipes passing through exterior walls and slabs on grade which do not have membrane waterproofing shall be of cast-iron or galvanized steel pipe or black steel pipe, Schedule 40.
3. Sleeves for pipes passing through exterior walls, slabs on grade and floors which are provided with membrane waterproofing shall be of threaded galvanized steel pipe fitted with companion flanges and arranged to secure membrane. Companion flanges shall be drilled and tapped in such a manner that bolting is effected from the outer (or upper) face only.
4. Sleeves for pipes passing through potentially wet floors that do not have membrane waterproofing such as in toilet rooms, cafeteria kitchens, serving areas, dishwashing rooms, utility cores, mechanical equipment rooms, and areas that are provided with fire protection sprinkler systems, shall be galvanized steel pipe, shall project 2 inches above the finished floors, and shall be caulked watertight.
5. Sleeves for pipes passing through all other floors and walls shall be constructed of galvanized or black steel pipe, standard weight.

B. Sleeves On New Work: On new work, sleeves shall be built into the walls and floors as the work progresses.

3.13 INSTALLATION OF CLEANOUTS AND FERRULES

A. Riser Connection to Sewer or Drain: Where soil, waste, or roof drainage risers connect to a sewer or drain extending from the building above the lowest floor, the fitting at the base of each stack or downspout shall be a sanitary tee or a combination Y and 1/8 bend with cleanout plug in the end of the run of the main.

B. Test Tees: Each vertical soil, waste, and vent pipe and each downspout and roof drainage pipe which connects to horizontal drain piping below ground shall be fitted with a test tee above the lowest floor or ground. Where accessible, test tee may be installed in the horizontal pipe at the base of the riser.

C. Cover Plates: Where cleanouts or test tees occur on concealed pipes in finished rooms, they shall be provided with a 1/8-inch thick, machine finished, brass cover plate of sufficient diameter to cover the opening in the finished wall or partition. The cleanout plug shall have a solid head, tapped for a 1/4-inch brass screw to secure the cover plate. Where cleanout plugs extend beyond the wall finish, the cover plates shall be of machine finished brass and shall be only of sufficient depth to fit against the wall to cover plug. Cleanout cover plates shall be painted to match adjacent wall finish.

D. Cleanouts Plugs For Threaded Fittings: Cleanout plugs for threaded fittings shall be in accordance with ANSI B16.12. Except for test openings, where size must be sufficient to admit test plug, bushings will be permitted on pipes 5-inches and larger to reduce plug size to 4 inches; cleanout plugs for piping 4 inches and smaller shall be the same size as the pipe.

E. Cleanout Plugs For Hub-and-Spigot Fittings: Cleanout plugs for hub-and-spigot fittings shall be screwed into ferrules caulked into the fitting. Ferrules and plugs shall be in accordance with ANSI B16.12, except that plugs required to be flush with the floor shall have square countersunk heads in lieu of raised heads.

F. Cleanout Plugs For Copper Drainage Lines: Cleanout plugs on copper drainage lines shall be installed in solder-joint fittings having threaded openings provided for the cleanout, or in solder-joint fittings with threaded adapters.

3.14 WATER PIPING INSTALLATION

A. General: Water piping shall be complete from service connection to all fixtures and equipment outlets. Sizes of pipes shall be as shown or specified.

B. Reaming: Ends of pipes and tubes shall be reamed before being made up.

C. Threaded Joints: Threaded joints shall be made up metal-to-metal, with a noncorrosive lubricant applied to the male thread only. Lampwick or other packing material shall not be used in making up threaded joints.

D. Chromium Plated Piping: Chromium plated piping shall be threaded and made up carefully, and not more than one full turn of thread shall be exposed beyond any fittings.

E. Long Screws and Bushings: Long screws and bushings (other than bushings cast in the sand) shall not be used on water piping.

F. Soldering: Ends of tubing and recesses of fittings to be soldered shall be thoroughly cleaned. Joints shall be assembled without binding. Solder shall penetrate fully and shall fill the joint completely. Joints shall be made using lead-free solder, as specified.

G. Joint Materials: All joint materials shall be free from oil, tar, and greasy substances, and shall be dry when placed in the joint. The material shall be handled with care to prevent contamination.

H. Copper Tubing: All copper tubing shall be free from cuts, dents or other surface damage at the time of final inspection. Damaged tubing shall be removed and replaced with new.

I. Copper Tube Anchoring: Horizontal runs of copper tubing over 50 feet in length shall be anchored to wall or floor construction. Anchors shall be located near the midpoints of the runs so as to force the expansion equally to the ends or in a direction where expansion can take place without excessive strain.

J. Swing Joints, Offsets, and Expansion Joints: Swing joints, offsets, and expansion joints shall be provided where necessary to accommodate expansion of piping, which will be approximately two inches in 100 feet of copper hot water piping.

K. Dielectric Couplings: Where non-ferrous metal piping and zinc-coated metal piping are joined, dielectric (insulating) couplings, fittings or unions shall be provided.

L. Reducing Fittings: Where pipe sizes shown or specified differ from the connection sizes of meters, pumps, fixtures, outlets, and the like, reducing fittings shall be installed close to them.

M. Pipe Branches: Branches from water supply mains shall be taken from the top, bottom or side, using crossover fittings where required by structural or operating conditions.

N. Upfeed Hot Water Return: On upfeed hot water distribution systems for which return circulation piping is shown, a 1/2" circulation connection shall be made at a point on each riser just below the highest outlet connection. Provide branch circulation lines with gate valves near the valves on corresponding supply lines.

O. Downfeed Hot Water Supply: Each downfeed main for a hot water supply system shall be graded upward to the first branch connection, which shall be taken from the top of the main. Beyond the first connection the main shall grade downward, and all branch connections shall be taken from the bottom of the main. Connect a 1/2-inch circulating line to the bottom of each downfeed riser. Provide branch circuiting lines with gate valves in locations corresponding to the supply branch valve locations.

P. Grading: Hot water supply and hot water circulating lines shall be accurately and uniformly graded to avoid traps which might impede or destroy circulation. All lines shall be graded so as to facilitate drainage.

Q. Unions: Unions shall be installed near points of connection to each piece of

equipment, and elsewhere as required for installation of piping, removal and replacement of regulating and control equipment and the like. Right and left couplings or nipples are prohibited.

R. Water Hammer Arresters: Water hammer arresters shall be provided where indicated on the drawings. Water hammer arresters shall be approved and installed in accordance with the requirements of PDI-WH201 and shall bear the PDI seal of approval.

S. Roughing: Roughing shall be provided for equipment furnished under other sections of the specifications. Where future extensions are indicated on the drawings, roughing shall extend to within the space to be served, and shall be valved, and capped or plugged.

END OF SECTION 15400.

SECTION 15500 FIRE PROTECTION

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.

1.1 GENERAL CONDITIONS

A. The requirements of Section 15010, 15030, 15050, and 15900 shall govern the work in Section 15500, where applicable, and where not in conflict with governing codes and ordinances. Division 1 is a part of this and all other sections of these specifications.

1.2 SCOPE

A. The work required includes the designing, hydraulically calculating pipe sizes, flows, and pressure, furnishing and installation of fire protection systems in accordance with the drawings, specifications, latest standards and codes for complete systems for the building.

B. The work specified in this section shall be installed by none other than a recognized fire sprinkler contractor. All fire protection system piping shall be hydraulically calculated. All systems shall be subject to the inspection and approval of the local fire authority or his representative for compliance of applicable standards.

C. All work shall be coordinated with other subcontractors.

D. The sprinkler system shall consist of the required number of sprinkler heads, piping, hangers, drains, test pipes, alarms, valves, and all other parts to assure a complete system to meet the requirements of the owner's insurance underwriter, local authority having jurisdiction, and in accordance with nationally recognized standards.

E. Codes & Standards:

Water Supply: Nat'l. Fire Protection Assoc. (NFPA) #24 - Uniform Bldg Code.
Wet Sprinkler System & Combined Systems: NFPA #13 and #14 - I.B.C.
Alarm Equipment: NFPA #70 & 72A
Standpipe & Hose Systems: NFPA #14 - I.B.C.
Supervision: NFPA #13 and #14 - I.B.C.

Temporary Fire Protection: NFPA #14 - I.B.C.
Sprinkler Heads: NFPA #13
Sleeves and Location: NFPA #13
Underground Mains: NFPA #24
Excavation and Backfill: 15010 of this specification

F. Work Included Elsewhere:

Fire Hydrants - by Site Utilities Contractor
Concrete Work - by General Contractor
Access Doors - By General Contractor.
Painting of sprinkler piping - By Mechanical Contractor.
Color coding or pipe identification - By Mechanical Contractor.
Wiring of flow switches and gate valve supervisory switches - By Electrical Contractor.

1.3 WORK BY FIRE PROTECTION CONTRACTOR

A. This contractor shall furnish and install all labor, material, and equipment to make a complete and working fire protection system fully tested and approved in accordance with the drawings, standards of this specification for the new building, and minor system modifications in the existing building.

B. Sprinkler System:

1. This system shall conform to NFPA #13 and #14 and U.B.C. Riser may be calculated, but shall not be smaller than 6". Sprinkler systems are to be light, ordinary, or extra hazard, as required by NFC-13 and the local fire authority.

2. System shall be hydraulically calculated. Sprinkler system shall be light hazard, except for casual ordinary and extra hazard group 1 in service areas. Density for light hazard areas shall be 0.10 gpm per sq. ft. over 1500 sq. ft. Remote area with a maximum head spacing of 225 sq. ft. Service area shall be density of 0.15 over 2000 sq. ft. with maximum spacing of 130 sq. ft.

1.4 QUALIFICATION OF DESIGNER

A. Designer shall be an engineering technician or Senior Engineering Technician (Level III or Level IV), NICET certification for fire sprinkler system design.

1.5 QUALIFICATION OF INSTALLER

A. It is intended that the system be designed and installed by a firm regularly engaged

in the design and installation business of Fire Sprinkler contracting. The Owner's representative may require evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor who cannot verify such experience, may be found not suitable to perform the work.

PART 2 - PRODUCTS

2.1 HANGERS

A. All hangers to be in accordance with NFPA Pamphlet No. 13.

2.2 SPRINKLER HEADS

A. Sprinkler heads shall be U.L. approved. "K" factors shall be the same on each system and/or floor. See plans for head types.

B. Sprinklers shall be of the proper temperature rating. Location of sprinkler head wherever reasonably possible shall be symmetrical and coordinated with the ceiling pattern.

C. Number and location of sprinkler heads shown on the drawings are schematic. Exact number and location of heads shall be determined by the system design, and architectural coordination.

D. Provide dry pendent heads in areas subject to freezing, only where wet piping can be run in heated space. Otherwise, provide antifreeze loops.

E. Provide sparehead cabinets in accordance with NFPA No. 13 and equip same with at least ten (10) chrome heads, six (6) brass heads, and appropriate wrenches.

F. Provide head guards in all areas where heads are subject to physical abuse.

2.3 VALVES

A. All valves and fittings shall be listed by Underwriters Laboratories or approved by Factory Mutual for fire protection duty and shall be installed in accordance with their listing and/or approval. Control valve shall have alarm supervisory switches with two sets of contacts and normally open/normally closed.

B. All indicating valves will be of the listed and/or approved type with an electric tamper switch approved for use with that valve.

C. Water hammer arrestors shall be provided ahead of all automatic valves to eliminate water hammer and shall be installed vertically in an accessible location.

2.4 PIPING

A. All piping above ground shall be Schedule 40 domestic steel pipe and fittings.

B. Thinwall and foreign made pipe will not be permitted on this project.

2.5 EARTHQUAKE BRACING

A. Install earthquake bracing in accordance with NFPA #13 Standards and local Fire Marshall's Office.

2.6 SLEEVES

A. Sleeves shall be furnished, together with their location and elevations to the construction manager, timely with required schedule or concrete pours. If sleeves are missed by this contractor, he shall be responsible for core drilling thru concrete at his own expense, and he shall be responsible for his cutting and patching. Sleeves shall be of the size, type, and length required by N.F.P.A. codes. See Section 15050 for "Sleeves".

PART 3 - EXECUTION

3.1 TEMPORARY FIRE PROTECTION DURING COURSE OF CONSTRUCTION

A. This contractor shall provide fire protection as required by NFPA #14 - Chapter 8, and shall be coordinated with the local fire department.

3.2 SHOP DRAWINGS

A. Shop drawings, submittals, and hydraulic calculations, as necessary and required, shall be submitted to the Owner's representative for approval prior to incorporating materials or equipment into the work. Shop drawings shall be complete and in accordance with NFPA #13, #14, #20, and all applicable standards, submittals, and equipment, valves, flow switches, controls, and other important items shall be complete, showing details, description, and characteristics; hydraulic calculations shall show flows, pressures, velocities, pipe size, and equivalent lengths as required for the system.

B. Calculations shall be arranged in an orderly manner with sufficient reference points for the approving authority to review and approve.

C. Testing shall be accomplished by this contractor for all required systems, equipment, and appurtenances, as required by the various standards and codes. The Owner's representative shall witness and sign off each item required. This contractor shall furnish required forms.

3.4 TESTS

A. Install all test pipes and valves as required by NFPA No. 13. Locate inspector's test valves and auxiliary drain valves above ceilings in areas approved by the Architect and provide hose bibb connections. Conduct all tests as required by NFPA Standards and Insurance Services Office and submit copies of completed test forms to the Owner.

B. All fire sprinkler related tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness or documentation, then they will be run late and all damage caused by the system, or caused in uncovering the system for such tests, will be borne by this contractor.

C. The local city Fire Marshall shall be notified (in writing) at least three days in advance of the following:

1. Hydrostatic test and final inspection of the underground, prior to backfilling.
2. Flushing of underground prior to connection to overhead.
3. Hydrostatic test and final inspection of overhead, prior to the installation of the ceilings.

3.5 GENERAL REQUIREMENTS

A. This contractor shall submit complete drawings, hydraulic calculations, and proper documentation to the local authority having jurisdiction and receive their approval before submitting such material to the Owner's representative for final approval. The contractor will be required to show proof of submittal to the Owner's insurance underwriter and local building authorities before installation may begin.

B. All work of this contractor will be coordinated with other trades to insure minimal changes to the sprinkler system from the designs. Careful coordination of mechanical and electrical ducts, pipe and conduit shall be required. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict the installation of the mechanical equipment and piping shall be in the following order: plumbing waste, rainwater, and soil lines' supply, return, and exhaust ductwork; water piping; fire protection piping; and pneumatic control piping.

C. Every effort shall be required to insure that the heads form a symmetrical pattern in the ceiling with the ceiling grid, the lights, and diffusers and grilles and as shown on the Architect's reflected ceiling plan. Offsets shall be made in piping to accommodate ductwork in ceiling. Heads should be symmetrical and all piping run parallel or perpendicular to building lines. In no case shall sprinkler heads be installed closer than 6" from ceiling grids or closer than approved distances from ceiling obstructions.

D. All sprinkler piping shall be run concealed unless approved by the Owner's representative. All lines will be run as high as possible so as to not interfere with

future changes to ceiling heights or other mechanical equipment. This contractor will be responsible for all sleeves, core drills, and sealing of penetrations in walls, floors, and structural members to facilitate the installation of the system, however, no holes in, or attachments to structural members will be allowed unless approved by the Owner's representative.

E. All required drains and test pipes will be installed and finished in a workmanlike manner, terminating at a proper location to accommodate the required outflow without damaging the building or landscaping. Drain and test pipe locations shall be approved by the owner's representative.

F. All piping and heads located in un-heated spaces shall be installed with a glycol loop system. Coordinate location with the owner's representative. Indicating valves with tamper switches shall be installed and wired as required by code. Coordinate with electrical contractor.

G. No piping or valve assemblies shall be run exposed in a finished area without the prior approval of the owner's representative.

3.6 JOB CLOSEOUT

A. This contractor shall assure that all placards, signs, and instruction manuals are in place, and all tests are run before any consideration for final payment will be considered. This includes maintenance manuals, hydraulic calculations placards, spare head cabinets and the proper number of spare heads, and instruction to on-site personnel.

B. This contractor shall, in addition to the above, furnish the owner one (1) set of mylar reproducibles of the sprinkler system "record drawings" for his project files.

END OF SECTION 15500.

SECTION 15700 - HEATING COOLING

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 SCOPE

A. The installation covers the furnishing and installing coils, pumps, piping systems, and all necessary trim and specialties, etc., as specified and shown on drawings or as required to provide the complete heating and air conditioning systems shown on the drawings and specified herein.

1.2 PIPE

A. A complete and ample system of hot water/glycol and chilled water/glycol piping shall be installed as shown on the plans.

B. Piping shall be properly graded and supported to prevent water and air pockets from forming, and to insure noiseless circulation throughout the system.

C. Branches leading from the mains shall be taken off from the top or sides of the mains at 90 deg., except where otherwise directed. These branches shall be arranged with swing connections to accommodate expansion and contraction.

D. All mains reducing in size shall be reduced with eccentric reducing fittings, with top of pipe level for water.

E. Run all piping as high as possible.

PART 2 - PRODUCTS

2.1 CHILLER

A. Furnish and install complete the packaged air cooled chiller as shown on the attached schedule and as specified herein.

B. **All installed chillers must meet sound requirements specified.**

C. It will be the chiller supplier's responsibility to provide necessary acoustical attenuation to accomplish the 55 dba property line noise levels while delivering the rated chiller capacity. The chiller supplier shall retain an independent acoustical engineer to test the installation under full load prior to building occupancy.

D. Unit will be furnished complete with factory start-up services.

E. Start-up services to include the following:

F. Upon delivery of unit to job site chiller manufacturer shall have a factory authorized service technician verify condition of chiller, including verification of factory refrigerant charge. Technician to provide a report to the general contractor. Chiller manufacturer shall correct any items required to facilitate chiller installation as directed to avoid any delay in project schedule.

G. Packaged Rotary Screw Chillers:

1. General: Provide the packaged air cooled rotary screw chiller as specified herein and as shown on the attached schedule. Chiller to consist of rotary screw compressor(s), compressor motors, evaporators, air cooled condenser, condenser fans, controls, starters and panels including gauges and indicating lights, complete louver package, auxiliary components and accessories required for complete chiller installation.

2. Provide manufacturer's standard packaged air cooled chiller unit specified in published product information, designed and constructed in conformance with this Section.

3. Provide lifting eyes or other means of lifting on all removable components weighing 50 pounds or more.

4. Casing: Construct of fine grain cast iron. Seal casing joints against leakage with gaskets.

5. Lubrication:

   a. Provide a forced oil circulation system with replaceable oil filter to insure positive pressure lubrication of journals, bearings and seals.

   b. Provide an automatic oil heater designed to separate refrigerant from oil. Provide oil heater power source independent of starter and controls power.

   c. Provide oil cooler which functions without city water connections.

6. Compressor Motors:

a. Provide 3600 rpm continuous duty, single-speed, squirrel-cage induction motors, refrigerant cooled, and arranged for wye-delta start.

b. Rate refrigerant cooled motor not to exceed 150 degrees F. at nominal full load conditions, and 180 degrees F. at worst case high or low voltage and 108 percent of full-load-amps. High motor winding temperature safety control shall trip at 220 degrees F. maximum.

7. Single point electrical connection: The chiller shall be factory wired to a single point high voltage power connection.

8. Motor Starters:

a. Provide a motor starter for each compressor, UL listed, of the magnetic star-delta either open or closed transition type. Provide magnetic, manual reset overload relays in each phase and undervoltage release.

b. Provide ammeter, and voltmeter to read each phase and an hourly run-time meter mounted in the starter cover.

9. Evaporators:

a. Provide evaporators of the shell-and-tube direct expansion type, designed, fabricated, tested, inspected and certified to comply with ASHRAE 15 and in accordance with ASME Boiler and Pressure Vessel Code, Section VIII.

b. Provide pressure relief devices, manufacturer's standard complying with ASHRAE 15. Provide relief valves for high pressure refrigerant chillers.

c. Sign evaporator for circulation of scheduled fluid flow rates and pressure drops.

d. Evaporator shall have refrigerant charging and transfer connections.

e. Provide self-supporting steel tube sheets with sufficient strength to withstand working pressures, and weld to vessel shells.

f. Provide intermediate tube sheets, maximum 5 feet on center, to prevent tube vibration.

g. Provide heat-transfer tubes, minimum 0.028 inches wall thickness,

measured at the thinnest point of the tube wall after finning or other tube enhancements, and arrange to be individually removable. Expand ends of tubes in tube sheets and ensure tubes fit tightly enough in the supports so that tubes shall not be subject to either crevice-corrosion failure or chafing-due-to-vibration failure.

h. Provide, manufacturer's fabricated steel vessels with flanged water connections, designed, fabricated, tested, inspected, certified and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII. Bolt to shell of the vessel. Provide removable covers and arrange external piping and fittings for clear access to the entire tube sheet.

10. Insulation:

a. Provide factory installed insulation on the evaporator having a maximum thermal conductivity of 0.28 Btu per hour per inch thickness per degree F. per square foot at 75 degrees F. Minimum thickness shall be 3/4-inch.

b. The insulation shall be cemented in place with a rubber based adhesive; all joints shall be neatly taped, or otherwise sealed, to provide vapor sealed joints.

11. Air-Cooled Condensers:

a. Provide separate air cooled condenser circuits for each refrigerant circuit, designed to comply with ASHRAE 15, and fabricate, test, inspect for a 400 psig test pressure. Condensers shall have 1/2" O.D. internally enhanced copper tubes with aluminum wave fins, and heavy duty cast aluminum vertical discharge air foil belt driven fans.

b. Provide low ambient control to 45° F.

c. Provide pressure limiting and pressure relief devices complying with ASHRAE 15.

d. Tube sheets shall be self-supporting, of sufficient strength to withstand working pressures, and welded to vessel shells. Include intermediate tube support sheets to prevent tube vibration.

e. Design tubes to be individually removable.

f. Provide manufacturer's fabricated steel water boxes with integral flanged water connections, designed and fabricated in accordance with ASME Boiler and Pressure Vessel Code, Section VIII. Bolt to

shell of the vessel. Provide removable covers and arrange external piping and fittings for clear access to the entire tube sheet.

12. Pump Out Unit: For high pressure refrigerant chillers, provide a system designed and fabricated to permit transfer and isolation of full refrigerant charge. Factory-assemble with pipe and valves as integral part of chiller. Include refrigerant high-pressure cut-out, valves and gauges. Pump out unit shall not rely upon chiller compressor for operation.

13. Capacity Control:

    a. Provide capacity controls designed and fabricated to regulate evaporator water leaving temperature.

    b. Design for capacity modulation, from full-load to scheduled minimum load under normal operation conditions, without overshooting and hunting.

    c. Provide each chiller with a digital controller with proportional and integral (P.I.) reset. Reset shall be adjustable zero to 3 degrees F. with a range 40 degrees F. plus or minus one-half percent accuracy.

14. Demand Limit Devices: Provide an adjustable control device to decrease compressor-motor power when power demand reaches selected percentage of full-load power demand; adjustable from 40 percent to 100 percent continuously.

15. Safety Controls: Provide factory wired safety controls to stop compressor if any of the following occurs. Design each cut-out to require manual resetting before compressor will start.

    a. Low refrigerant pressure in evaporator.
    b. High condenser pressure.
    c. High motor-winding temperature.
    d. Low differential oil pressure.
    e. Loss of any phase in electric power.
    f. High oil temperature.
    g. High bearing-temperature.

16. Operational Controls: Provide a control system as follows:

    a. Provide controls to ensure that compressor will start under unloaded condition.
    b. Provide an anti-recycle timer, factory-wired, to limit compressor-motor restarts at scheduled time intervals.
    c. Provide a low evaporator-water-leaving-temperature cut-out with

manual reset from manufacturer's standard recycle timer.

d. Control oil pump (as applicable) to ensure lubrication of compressor motor bearings and seals.
e. Start main oil pump (as applicable) before compressor starts.
f. Prove oil pressure (as applicable) through pressure interlock.
g. Maintain lubrication during normal operation.
h. Automatically restart compressor after power-failure provided anti-recycle timer is ready for restart.

17. Control Panel: Manufacturer's design complying with the National Fire Protection Association (NFPA) 70, "National Electrical Code."

a. Provide gauges or meters or LED read out to indicate refrigerant pressure and temperature in evaporator and condenser, and oil temperature and pressure.
b. Provide electrical interlock to prevent chiller operation when chilled-water pump is not operating.

18. Running and Warning Indicators: Provide warning lights with nameplates or a safety alarm light working in conjunction with self diagnostic, digital circuitry which displays status in an LCD for the following:

a. Oil pump operation, "Normal." (As applicable)
b. Low chilled water temperature cutout.
c. Low water flow cutout.
d. Oil heater operation, "Normal."
e. Low evaporator refrigerant pressure or temperature cutout.
f. High condenser pressure cutout.
h. High motor-winding temperature cutout.
i. Low oil pressure cutout.
j. Motor-overload cutout.
k. Provide elapsed time meter designed to automatically record total chiller operating time, in hours.

H. Chiller enclosure shall be factory assembled of weatherproof vandal resistant construction with locking hinged access doors to compressor chamber and vandal resistant coil guards on the condenser coils. Chiller to be complete with full height louvered panel package to enclose entire unit with no change in unit capacity.

I. Chiller manufacturer to provide modular acoustical plenums as specified elsewhere in this section to match chiller dimensions.

J. Factory Finish: Provide manufacturer's standard finish including metal surface cleaning before coating, one coat of 1 mil. thick modified alkyd primer, and a finish coat of 1 mil. thick alkyd enamel on factory-fabricated chiller work, including exposed ferrous metal surfaces and factory-installed insulation.

K. Entire unit shall carry a 1-year full parts and labor warranty, and the compressor shall carry a 5-year full parts and labor warranty. The warranty period shall start when the certificate of occupancy is issued --- not when the chiller arrives on site.

L. ARI Standard 575-87 sound pressure levels one meter from the chiller assembly shall not exceed:

FREQUENCY BAND

	63	125	250	500	1000	2000	4000	8000	dbA
DB	78	81	81	81	81	78	75	71	85

M. CHILLER INTERFACE PANEL

1. Furnish and install complete (including all wiring and commissioning) a microcomputer similar to Dunham-Bush NC-25-4 to interface with existing chiller and provide the following sequence of operation:

   These units are to be equipped for master control in response to a command for cooling. Chiller 'CH-2' shall be designated the Master and shall be fitted with a selector switch that allows either of the two units to be selected the Lead. By definition the Lead unit will be the first to start and the last to shut off. The other unit will be designated the Lag. When the cooling command contacts close, the Lead is active. A chilled water flow switch and pump interlock in the Lead unit's control circuit signals the chiller that flow has been established. If the leaving chilled water temperature is above the desired leaving water temperature set point, the Lead chiller will start and load up as necessary to maintain its leaving chilled water temperature. If the Lead chiller reaches its full capacity and is unable to maintain its leaving chilled water temperature within two degrees of the setpoint, then after a five minute delay the Lag chiller will be activated. A chilled water flow switch interlock in the Lag chiller control circuit signals the chiller that flow has been established. If the leaving water temperature is above the desired leaving water temperature set point, the Lag chiller will start and load up as necessary to maintain its leaving chilled water temperature. Leaving water temperature set point must be the same for both chillers 'CH-1' and 'CH-2'. The Lead chiller may unload as the two chillers share the load equally. As the load decreases, both chillers will begin to unload. If the load decreases to 50 percent of the Lead chiller's capacity, then the Lag unit will be signaled to shut down after a two minute delay. The Lag unit will shut down, and the Lead chiller will continue to run, increasing in capacity as necessary to match the chilled water load.

N. Manufacturer: Packaged chiller shall be Trane, York, McQuay, Carrier, or Dunham-Bush.

2.2 MODULAR ACOUSTICAL PLENUMS

A. General: Furnish and install modular factory fabricated acoustical plenums as detailed and specified. Chiller manufacturer shall verify that the acoustical attenuation plenums are dimensionally and acoustically compatible with chiller provided.

B. Materials & Construction:

1. Plenums shall be mounted level. All panel sheets shall be 18 gauge G90 galvanized steel. Sound retarding and absorbing fill shall be incombustible, inert, mildew resistant and vermin-proof. Internal panel reinforcement shall be provided as required. Perimeter and internal reinforcement and panel sheets shall be welded and/or riveted to form a rugged metal sheathed acoustical panel. The face sheet panel assembly shall compress and hold the fill materials in place under severe conditions of vibration such as encountered in shipment, installation, and operation.

2. Construction of plenums to conform to details shown on plans and facilitate service to chiller fans. For maintenance reasons, each section not to exceed 100 lbs.

C. Factory Finish: Match chiller manufacturer's standard finish including metal surface cleaning before coating.

D. Accessories: Floor channels shall be G90 galvanized steel. Panel connectors shall be 16 gauge G90 galvanized steel for greater strength. All panel accessories and trim shall be made of 18 gauge G90 galvanized steel furnished in standard lengths to be field cut as required. Openings for fan and duct connections where required shall be provided by the plenum manufacturer. Manufacturer to provide means to allow drainage of individual sections to outside of enclosure. Pipe and conduit penetrations shall be located and cut in the field and sealed in accordance with the Manufacturer's instructions. Fasteners shall be zinc plated, #12 x 1", self-drilling, self-tapping hex head sheet metal screws located 12 inch on center.

E. Acoustical Performance: Acoustical panel ratings shall be determined by the dual reverberation room method in accordance with ASTM specifications E-90-81, E413-73, C423-81a, E795, or latest versions thereof. The test set-up and procedure shall be such that all effects due to flanking transmission, standing waves and test chamber sound absorption are eliminated. Data shall be presented for tests conducted using current production samples. The minimum allowable transmission loss (TL) of the panel, including all components, when tested in accordance with ASTM E-90-81 and E413-73, or the latest versions thereof, shall be as follows:

Transmission Loss in Decibels:

Octave Band	2	3	4	5	6	7	
Center Frequencies, Hz	125	250	500	1000	2000	4000	STC
Transmission							
Loss 4-1/4"	22	29	40	48	54	60	41
(TL) 2-1/4"	21	24	35	43	52	57	37

F. The composite panel assembly, when tested in accordance with ANSI/ASTM C423-81a and E795, or the latest version thereof, shall have minimum absorption coefficients as follows:

G. Sound Absorption Characteristics:

Octave Band	2	3	4	5	6	7	
Center Frequencies, Hz	125	250	500	1000	2000	4000	STC
Absorption 4-1/4"	0.86	1.09	1.22	1.06	1.05	1.04	1.10
Coefficients 2-1/4"	0.31	0.82	1.19	1.12	1.07	1.06	1.11

H. Structural Performance: The complete plenum structure shall be self-supporting. Where spans, pressures, and wall loadings require additional structural strength, it shall be furnished either by additional panel reinforcement or additional structural members and/or pipe columns. Additional structural support shall be designed to assure that the plenum will be air-tight and not deflect more than 1/240th of the longest span. Metal surfaces shall be galvanized except exposed structural members and/or pipe columns which shall be HR steel with factory applied prime coat paint.

I. Fire Hazard Rating: Plenum design shall meet the following UL Fire Hazard Ratings as per ASTM specification E-84, or the latest version thereof.

Flame Spread - 15
Fuel Contributed - 0
Smoke Developed - 0

J. Installation: Plenum manufacturer shall furnish complete erection drawings and installation instructions. Each panel shall be marked to match the drawings.

K. Warranty: Plenum manufacturer shall warrant that when plenums are installed in strict compliance with manufacturer's instruction.

L. Certification: The manufacturer shall supply certified test data on transmission loss and absorption coefficients to the architect/engineer. All rating tests shall be conducted utilizing the same panels. This facility shall be open to inspection at the request of the architect/engineer.

2.3 HOT WATER AND CHILLED WATER SPECIALTIES

A. Furnish and install complete the water specialties including all air vents, and specialty items required to provide a complete and operable hot and chilled water system.

B. Manual air vents shall be installed at all high points in the water system. Air vents shall be 3/8" ball valves and shall be installed on a 1/2" pipe nipple--6" long. Run 1/4" copper tube from vent to near floor--anchor tube securely to wall, pipe, or structural member.

2.4 FAN COIL UNITS

A. Furnish and install complete the horizontal and vertical fan coil units shown and specified on the plans.

B. Vertical units shall be the partially recessed or surface-mounted, as shown on plans, Architectural Series with 16 gauge steel panels, wall guard, and extruded aluminum discharge and return grilles. Units shall have hinged access doors at each side with vandalproof key latches.

C. Horizontal units shall be the concealed series with discharge and return duct collars.

D. All units shall have insulated casings, filter sections, F.C. centrifugal fans, 3-speed motors and controls.

E. Units shall have 1-row hot water coils and 3 row chilled water coils (see schedule on plans for capacities), coils shall be nonferrous construction with .035" thick copper tubes with air vents at high points.

F. Units shall be Airtherm, Carrier, Erincraft, or American Air Filter.

2.5 FACTORY BUILT AIR HANDLING UNIT

A. Factory built air handling units shall be horizontal type with coil requirements and fan capacities as listed on the drawings.

B. Each air handling unit shall be complete with insulated casings, mixed flow fans, internal spring type vibration isolation, stainless steel drain pans, heating coils, cooling coils, return air acoustical plenum section with double wall construction and structural floor air filter media and frames, fan motors with adjustable bases, belt guards, and belt drives. The signal to control inverter drives will be received from the ATC contractor.

C. Mixed air plenum and filter for all custom air handling units shall be provided with a waterproof drain pan and drain connection. Pan shall be piped to floor drain.

D. Fresh air and return air dampers shall be low leakage parallel blade units similar to Ruskin CD-50 or approved equal.

E. Sound Ratings:

1. Each air handling unit shall be constructed and shall operate for all conditions of air flow (including full load to 30% of full load air flow for each unit serving variable air volume systems). Sound rating required for the completed installation shall be achieved with the air handling unit equipped with factory installed internal sound attenuators if required to meet acoustical criteria hereinafter designed, constructed and installed with the room construction as indicated on the Architectural and Structural Drawings for this Project and vibration isolation as indicated in these Specifications and on the Mechanical Drawings.

2. The air handling unit manufacturer shall conduct testing to demonstrate the acoustical performance of the air handling unit specified. The acoustical measurements shall be made with a one-third octave band or octave band analyzer and w/the unit operating at 100%, 75%, 50%, 35% and 20% of design air flow capacity.

ACOUSTICAL PERFORMANCE: Sound Power Level @ 10 E-12 Watts

BAND	63	125	250	500	1000	2000	4000	8000
Absorp Coefficient of Panel		.89	1.20	1.16	1.09	1.01	1.03	.93
Transmission Loss of Panel	26	23	30	42	51	59	58	58
Fan Sound Data: (DB)								
AHU-1	90	89	95	97	94	93	81	83
At Discharge Opening	81	88	83	86	83	82	84	73

F. Unit Casings:

1. Units shall have 4" thick double wall construction with 18 gauge galvanized outer sheet and 22 gauge galvanized perforated inner sheet. Galvanized

metal shall not be painted. Casing shall be reinforced and braced with steel angle framework. Casing shall consist of a fan section, a coil section or sections a discharge plenum with internal sound attenuators and outlet, and a stainless steel drain pan as indicated on the Drawings. Suitable gaskets shall be provided at all joints between casing sections downstream of the fan. Stiffeners shall be provided, to prevent unit casing pulsation. The unit drain connection shall be a least 4" above the floor to the bottom invert of the stainless steel condensate pipe. The unit casings shall not exceed the maximum dimensions shown on the Drawings.

2. Coil section shall completely enclose all connections, coil headers, and return bands. Coil frames shall not be used as structural members of the coil section. The entire cooling coil casing frame shall be stainless steel with the coil elevated above the lower condensate drain pan on stainless steel channel supports. The coil section shall be constructed in such a manner that the coils can be removed without affecting the structural integrity of the casing. Coil casing shall be constructed of stainless steel, and it shall have intermediate stiffeners and gaskets so there is no bypass air between the coil fins and the coil casing or between the coil casing and the drain pans.

3. The air handling manufacturer shall provide factory installed copper chilled water piping unions, stop/balancing valves, test plugs, etc., within the unit. See typical coil piping detail on the Drawings. The piping internal to the unit shall be ASTM B-88-72 H23.1-59 Type L hard drawn copper water pipe and sized to limit the water velocity to be no more than 8 fps at design flow. All piping and fittings shall be soldered with Sil-Fox Stay-Brite. Internal piping shall be terminated at the side as indicated on the drawings with a Victaulic Style 47 (A-53) "Clear Flow" Dielectric fitting configured for threaded x threaded or threaded x Victaulic groove and shall be sized as shown on the Drawings. The internal piping shall be equipped with air seals at the casing penetrations similar to Kennard Industries Inc. flexible vinyl grommets.

4. The air handling unit manufacturer shall pre-wire the fan motor, temperature sensor, internal vapor-proof lights and switch on the outside of the casing for a complete pre-wired package. Unit wiring shall terminate in a NEMA 1 enclosure terminal panel with tagged terminal strips.

5. The lower stainless steel drain pan or stainless steel auxiliary drain pan shall extend under the complete coil section and all chilled water piping and shall be rigid and watertight with a 1-1/4" stainless steel pipe drain connection on the coil piping connection side. Drain pans installed on top of an insulated bottom panel shall be 16 gauge stainless steel and do not require insulation. The lower stainless steel drain pan shall extend at least 24" beyond the leaving side of the coil and be pitched 5/8" toward the cooling coil and shall be constructed in a "V" section to meet IAQ requirements. The entire lower drain pan shall be sloped within the unit at least 1/2" toward the drain connection. Stainless steel 20 gauge intermediate drain pans which slope 1/2" back toward the leaving air

side of the cooling coil shall be provided for all stacked chilled water coils which do not have internal drain troughs within the coil section. All intermediate drain pans shall be furnished with copper drain piping to transfer the condensate to the lower pan.

6. Access door on the fan section shall be a minimum of 24" wide. The access door shall be hinged and allow for access to the fan and discharge coil section. The access doors shall be located so that the unit may be entered from the coil piping and access side of the unit, regardless of the mounting arrangement. Oversized coil access panels to be provided as required for coil service and maintenance in areas with limited clearance. Doors shall be equipped with Ventlok Style 310 latch and Ventlok Style 150 or KASON 1061 hinges, or approved equal. All access doors shall have a padlocking feature. Door insulation shall be separate from unit insulation and shall be as specified for unit casing insulation.

7. The air handling unit casing shall have a field supplied and installed discharge plenum. The discharge plenum shall bolt to discharge side of the air handling unit and shall be gasketed at the joints. The discharge plenum shall have the same dimensions as the unit casing. The discharge plenum shall extend from the unit casing as required for supply air duct connections or a minimum of 36" horizontally or one fan diameter. The discharge plenum shall be equipped with internal sound attenuators as required to comply with the specified for the unit casing. The sheet metal discharge plenum shall provide the duct connections as shown on the Drawings. The static pressure loss of the internal sound attenuators shall be included in the internal static pressure loss of the air handling unit.

8. Unit casing, discharge plenum and return air plenum insulation shall be 4" thick, 1-1/2 lb. density glass fiber acoustical, noncombustible, vermin-and odor-proof and mildew resistant.

9. A return air plenum sound attenuating casing section shall be provided on the inlet of the air handling unit. The return air plenum shall extend from the air filters a minimum horizontal distance as shown on the Drawings. The return air plenum shall have the same dimensions as the unit casing. The plenum shall have double wall construction with perforated metal internal liner. The return air plenum floor shall be reinforced galvanized steel suitable for a walking surface with an integral structural frame with air handling unit. Openings from the equipment room to the unit shall be on the side of the plenum to facilitate servicing of the filters. The openings of the plenum shall be sized for a maximum face velocity of 1000 fpm.

10. The entire air handling unit shall be field installed by the Contractor on NRC ribbed neoprene pads so that the entire unit is pitched toward the drain connection at least 1/2" parallel to the face of the cooling coil. The condensate drain pan shall drain dry upon air handling unit shutdown. The air handling unit

manufacturer shall indicate on the shop drawings the location and quantity of the neoprene pads for field installation by the Division 15 Subcontractor.

G. Axial Flow Fans, Shafts, and Drives:

1. All fans shall be in-line mixed flow type, direct or belt driven with inlet vanes and belt guards as manufactured by Woods or American Fan. The fan housing shall be constructed at the wheel raceway and inlet bell to maintain precise tolerance. Each fan shall have an Air Monitor Corporation "Volu-probe/FI" airflow traverse probe factory installed on the fan inlet bell. All sheet metal parts of the fan shall be cleaned, conditioned and galvanized after assembly. In order to establish fan test curves, each type of fan shall be tested in accordance with AMCA STD 210-85. Fan test curves shall be submitted by the unit manufacturer for review by the Project Engineer.

2. Fans, sheaves, motors, belts and vibration isolation shall be factory assembled within the fan section casing. The air handling unit manufacturer shall supply balanced fans, motors and sheaves. Air handling unit fans, bearings and sheaves shall be balanced to a maximum of 1.5 mil peak-to-peak on the horizontal and vertical plane as measured at the fan mounting leg. Balancing shall be to a maximum of 5 mil peak-to-peak in the axial direction at the fan rotational frequency, and shall be measured adjacent to the fan inlet and bearing. Matched components shall be factory balanced continuous 25% to 100% rpm. Factory balancing data shall be so certified in writing by the manufacturer. Should the air handling unit develop vibration and/or balance problems after the installation and prior to the expiration of warranty period, in the sole opinion of either the Engineer or the Owner, the unit manufacturer or an independent testing agency shall perform a field balancing test using a portable IRD to verify compliance with the hereinbefore specified balancing requirements. The manufacturer shall replace all components that cannot meet these balance and vibration requirements without additional cost to the Owner.

3. Fan drives shall be selected with a minimum belt horsepower capacity of 120% of the motor nameplate horsepower. All drives shall conform to industry tolerances as set forth in "Engineering Standard for Multiple V-belt Drives-1972" as adopted by the Mechanical Power Transmission Association and the Rubber manufacturers Association, Inc. The selection calculations shall include the correction factor for arc of contact. The fan drive components shall be as follows:

   a. The motor sheaves for each typical floor unit shall be non-adjustable type selected for the rated fan rpm as determined by the fan requirements scheduled. Fixed sheaves shall be one of the manufacturers listed for the fan sheaves.

   b. The fan sheaves shall be non-adjustable type with removable machined

on all contact surfaces. Fan sheaves with over three grooves shall be dynamically balanced. Fan sheaves with three grooves or less shall be statically balanced. If weights are required for balancing, they shall be welded to the sheave. The fan sheaves shall be as manufactured by Browning, Eaton Yale and Towne, Dodge Manufacturing Company, Fort Worth Steel and Machinery Company, or T.B. Woods, if they comply with these specifications.

c. The belts shall be standard "V-groove" type suitable for the service intended with the capacities specified hereinbefore. The belts shall be closely matched and tagged prior to shipment. If in the opinion of the Engineer, the belts do not appear to be properly matched during operation, they shall be rechecked and, if necessary, replaced with another closely matched set of belts at no additional cost to the Owner. Drives shall be: Gates, Durkee-Atwood, Goodyear, Uniroyal or Browning.

d. Fan shafts shall have SKF, Sealmaster, Dodge, Timken, Fagan or Fafnir externally or internally mounted, grease-lubricated, self-aligning ball bearings on each end of the shaft. Bearings shall have a minimum life of 200,000 hours at design operation conditions. Life lubricated sealed bearings will not be acceptable. Fan shaft bearings shall have the grease lines extended to a common point inside the unit housing near the fan inlet on the access door side of the unit. In addition, the bearing on the drive end of the shaft shall have a grease line extended to the fan section. All grease lines shall terminate in a Zerk fitting in the fan section.

e. Fan wheel shall be precision manufactured with mild steel with radically projected blades with a mixed flow cross-sections. All wheels shall be dynamically balanced and keyed to fan shaft.

f. The fan shaft shall be solid AISI-C1949 hot rolled steel, turned and polished. Close tolerance shall be maintained where shaft makes contact with the bearings. Fans shall not be cantilevered. Fans shall not pass through their first critical speed as the unit comes up; to the rated rpm.

g. Motors for belt driven fans shall be factory mounted directly above the fan housing, internal to the unit. For units AHU-1, AHU-2, and AHU-4, the motor shall be single winding - single speed and shall operate at 1800 rpm. For unit AHU-3 the motor shall be two speed - two winding and shall operate at 1800/1200 RPM. Each motor shall be mounted to an adjustable base rigidly supported to the fan housing with "lock-down" feature. Motor shall have an extended shaft to accommodate the fixed pitch motor sheaves specified herein. Motors shall be of the same manufacturer as the inverter drive for units with adjustable speed

fan drive controller.

H. Coils:

1. Coils shall be constructed with copper tubes with minimum of .035" thick walls and aluminum plate fins. Supply and return connections shall be on the same end of the coil. Fins shall be bonded to the tubes by means of mechanical expansion of the tubes.

2. The entire coils casing shall be stainless steel, air between the finned element and the coil casing anywhere along the entire length of the coil casing, shall have intermediate stiffeners if over 5'-0" length.

3. Coils shall have copper or brass pipe, cast iron, or cast steel headers as required for working pressure specified, and manual air vent connections except on those return connections where the coil header piping is designed to be self-venting. Coils shall have minimum one-half circuit configuration as required to meet the capacities at low water velocities.

4. Coils shall be tested by air pressure under water. Coils shall be tested a 1-1/2 times the specified pressure classification and as indicated on the riser diagrams, but the test pressure shall in no case be less than 250 psig, nor more than 500 psig.

5. Chilled water cooling coil shall be not less than four (4) rows deep with a maximum of 148 fins per foot, but shall be more rows of required to meet or exceed the specified design load for the sensible heat removal requirements as well as the total heat removable. Chilled water cooling coil ratings shall be in accordance with ARI (Standard 410) certified data except capacity shall meet design capacity without any design tolerance and the temperature variation tested as specified hereinafter. Tubes shall be 1/2" or 5/8" O.D. and shall have a minimum wall thickness of 0.035". Flat fins shall have a minimum wall thickness of 0.0075". Cooling coil capacity shall be in accordance with chilled water flow and temperatures scheduled. Water velocity in the tubes shall not exceed five (5) feet per second and the water pressure drop through the coil shall not exceed 30 feet w.g. at design conditions. Water velocity in the tubes shall not be less than one foot per second at 36% of the design water quantity scheduled.

6. The cooling coils shall be tested in accordance with ARI test procedures. The test of 100% capacity shall be with the design air flow and water flow, and the total heat transfer and leaving air temperature shall be determined. Capacities shall be corrected for altitude effects.

7. Coil calculations and selection data to ARI Standard 410 shall be submitted with Shop Drawings.

8. These Specifications set forth in the minimum requirements for chilled water coils. Coils shall be: Carrier, Trane, York, Temptrol, Aerofin, or Heatcraft.

9. Provide an integral extruded aluminum, galvanized or painted and bolted or welded filter retainer frames for the specified Type "A" filters unless otherwise specified. Frame shall be suitable to accommodate the specified filters at maximum filter face velocity of 500 fpm. Filter media for the air handling units shall be as specified.

10. Shop Drawings shall indicate specifically that the construction, fabrication, etc., of the units to be furnished comply with these Specifications.

11. Dimensions for air handling unit AHU-2 shall not exceed dimensions scaled on enlarged mechanical plans. Oversized coil access to be provided as required for coil service and maintenance.

12. The Owner and Engineer may, upon written notice, observe the air handling units for this Project under manufacture testing at the factory prior to shipment. The Mechanical Contractor shall notify the Owner and Engineer in writing at least three (3) weeks prior to the first air handling unit production date.

13. See Acoustical Performance Chart which is a part of this specification section for allowable sound levels.

14. Units shall be: Aire-Systems, Scott Springfield, Trane, Pace, Temtrol, or Buffalo Forge.

2.6 FINNED RADIATION

A. Furnish and install complete the baseboard panel type radiation as shown and scheduled on the drawings and specified herein.

B. Radiation elements shall be Panel Radiator Inc., Thermoline or Runtal**.**

PART 3 - EXECUTION

3.1 COORDINATION

A. All equipment and piping shall be arranged to allow for easy maintenance and access to service valves.

B. Provide valves and unions or flanges at all pieces of equipment to allow maintenance.

C. Install all automatic valves, sensor well, flow switches, etc., as directed by the control contractor.

3.2 INSTALLATION OF CHILLERS

A. General: Install chillers in accordance with manufacturer's installation instructions. Install units plumb and level, in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install floor-mounted units on 4 inch high reinforced concrete pad, 4 inches larger on each side than chiller base. Cast anchor bolt inserts into the pad.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16.

D. Control: Coordinate field-installed automatic temperature control requirements with other sections of Division 15.

E. Manufacturer's Supervision: Chiller manufacturer shall supervise field assembly (if any) and installation of chiller work, with factory-trained technical service representative, for minimum of 2 working days. Prepare manufacturer's written report of installation, signed by representative.

1. Include leak testing, evacuation, dehydration, vacuum pumping, and charging in scope of supervision by manufacturer's representative.
2. Include lubrication, including filling of reservoirs, and confirming that lubricant is of quantity and type recommended by manufacturer in scope of supervision by manufacturer's representative.
3. Paint damaged and abraded factory finish with touch-up paint matching factory finish.
   a. Grounding: Provide positive electrical equipment ground for chiller equipment and components where indicated.

F. Start-Up: Start-up rotary screw chillers, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative.

1. Test controls and demonstrate compliance with requirements.
2. Replace damaged or malfunctioning controls and equipment.
3. Furnish sufficient refrigerant and dry nitrogen for pressure testing under manufacturer's supervision.

G. Field tests during chiller installation and start-up tests shall not be considered as fulfilling requirements of commissioning tests.

3.3 INSTALLATION OF PUMPS

A. General: Install pumps where indicated and in accordance with manufacturer's published installation instructions.

END OF SECTION 15700.

SECTION 15800 - AIR DISTRIBUTION

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 SCOPE

A. Work shall include the air distribution, ventilation, and exhaust duct systems, and all materials, equipment, and labor required to complete the systems shown on plans and specified herein.

PART 2 - PRODUCTS

2.1 DUCT CONSTRUCTION - GENERAL

A. Construct all ducts, plenums, etc., of the gauges specified in the latest editions of the applicable SMACNA manuals, unless otherwise shown. Sheets shall be free from blisters, slivers, pits, and imperfectly galvanized spots.

B. Duct construction and installation details shall comply with the latest edition of the SMACNA Duct Construction Standards.

C. Ducts from the fan unit discharge to VAV terminal boxes shall be constructed to meet the requirements of a +4 inch pressure class. All other supply air ducts shall be designed to meet the requirements for +2 inch pressurized ducts. All exhaust ducts shall be -2 inch suction ducts.

2.2 +4" PRESSURE CLASS DUCTWORK

A. All ductwork on the discharge side of Air Conditioning units to the terminal boxes shall be +4" pressure class duct. It is the essence of the duct system to have a minimum pressure loss. Therefore, ducts shall be run in a straight line and shall be run so that the lowest beam or obstruction shall generally determine the centerline of the straight run. Eccentric reducing transition shall be avoided, but may be used where space is a determining factor. Bends and elbows other than those shown on the drawings shall have the approval of the Architect before installation. No pipes, conduits, or any other obstructions shall be run through +4" P.C. ductwork.

2.3 ROUND DUCTWORK +4" PRESSURE CLASS

A. The round +4" P.C. HVAC ductwork, fittings, and accessories shall be factory fabricated, spiral conduit. Ductwork may, when approved by the Architect, be fabricated in a 26 ga. standing rib configuration. The ducts shall be constructed of rust-resistant zinc-coated steel and shall be of the sizes called for on the drawings.

B. All fittings in the round ducts shall be factory fabricated to match the spiral ducts and shall be of the same manufacturer.

C. Round duct joints in diameters through 50 inches shall be sealed as follows:

D. Approved sealer equal to "Hard Cast" shall be applied to the coupling and fittings. Sealer is applied to the outside of the joint, extending 1 inch on each side of the joint bead and covering all screw heads. Plastic backed tape is immediately applied over the wet sealer.

E. The duct sealer must be specifically formulated for the job sealing the field joints for high-pressure systems. The sealer shall be compatible with plastic-backed duct tape so the two shall cure and bond together. Samples of sealer and tape and the specification data sheets shall be submitted to the Architect for approval.

F. Flanged joints shall be sealed by Neoprene Rubber Gaskets.

2.4 ACCESS DOORS AND PANELS

A. Location: Provide access doors in casings, plenums, and ducts where shown on the drawings and where specified for ready access to operating parts including fire dampers, smoke dampers, valves, and concealed coils.

B. Pressure Clarification: Construct and install access doors in accordance with SMACNA Standards to suit the static pressure classifications and the locations where installed.

C. Access Doors in Ducts: Provide and size doors as follows:

1. Minimum 24-inch by 24-inch clear opening.
2. When field conditions require an access opening smaller than 16-inch by 12-inch, provide a 24-inch long removable section of casing or duct, secured with quick acting locking devices, 6 inches on centers, to permit ready access without dismantling other equipment.

D. Door Requirements: Provide doors in casings and duct as follows:

1. Arrange doors so that system air pressure will assist closure and prevent

opening when the system is in operation.

2. Coordinate doors and equipment to provide unrestricted passage through clear door opening, without removal of any equipment.
3. Where pressure regulating dampers are installed in ducts or plenums, provide access doors with a clear wire glass observation port, 6-inch by 6-inch minimum size. Anchor port with structural metal frame, resilient gaskets and stainless steel bolts.
4. Hinges for doors in zinc coated or aluminum construction shall be steel or iron, zinc coated with brass pins.
5. Hinges for doors in copper, copper nickel alloy construction shall be all brass.

2.5 CLOSURE COLLARS

A. A duct ending at a wall or partition shall have the edge turned back to form a closure collar and flanged tight to the wall or partition so that no sharp or ragged edge appears.

2.6 FLASHING

A. Where ducts pierce roof construction, the flashing shall be provided as part of Division 7.

B. The equipment bases and duct opening bases on the roof shall be constructed by this Contractor as shown on the drawings. The base shall be constructed to fit the equipment approved for construction. This Contractor shall construct and install a weatherproof inverted pan over the wood bases to act as a counterflashing and weatherproof hood for the base. All openings through the pan for equipment mounting shall be sealed weathertight with lead washers.

2.7 TEST HOLES IN DUCTWORK

A. Test holes for testing air quantities in ducts shall be installed at locations to be specified by the Balancing Contractor. Rubber stoppers shall be provided for closing the test holes. Where these holes are installed in insulated ductwork, a removable plug of approved insulation material shall be provided. An instrument port shall be provided in the following locations for each fan system.

1. Return air shaft and/or duct upstream of sound traps
2. Return air fan plenum
3. Main return air duct upstream of fresh air dampers
4. Mixed air plenum
5. Supply fan plenum

B. Additional ports are to be installed in locations determined by the Architect.

C. Instrument ports shall be die cast with screwed cover for the insulation thickness

specified. Ports shall be located outside of the plenum with 20-gauge sheet metal sleeve of the same size as the port opening, passing through insulation where ducts have interior insulation.

2.8 CLEANOUT OPENINGS

A. Duct systems shall have cleanout openings equipped with tight fitting sheet metal doors. Doors shall be tightly latched without the use of tools.

2.9 FIRE-RESISTIVE ACCESS OPENING

A. When cleanout openings are located in ducts within a fire-resistive shaft or enclosure, access openings shall be provided in the shaft or enclosure at each cleanout point.

B. These access openings shall be equipped with tight-fitting sliding or hinged doors which are equal in fire-resistive protection to that of the shaft or enclosure.

2.10 CLEARANCES

A. Duct systems shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than three inches, provided the combustible material is protected with materials approved for one-hour fire-resistive construction on the duct side.

2.11 EXHAUST OUTLETS

A. Exhaust outlets shall extend thru the roof, unless otherwise noted. Such extension shall be at least two feet above the roof surface, at least 10 feet from any adjacent building, property line, or air intake opening into any building, and shall be located at least 10 feet above the adjoining grade level.

2.12 BRANCH TAKEOFFS

A. Branch takeoffs shall be as shown on the drawings, and shall be fitted with adjustable lock balancing dampers, complete with locking quadrants. Where dampers are not accessible for adjustment from above, concealed ceiling regulators with adjustable chrome-plated covers shall be provided.

2.13 WALL PENETRATIONS

A. All new and existing ducts penetrating structural or architectural walls shall be sealed air and sound tight.

2.14 FIRE RATED SURFACE PENETRATIONS

A. All new and existing ducts penetrating fire rated surfaces shall be sealed as

directed in 15050.

2.15 DUCTWORK

A. All ductwork shall be fabricated and installed in compliance with the latest SMACNA duct manuals.

B. Sheet metal ducts shall be properly braced and reinforced with and, where they protrude above roof, they shall be properly flashed.

2.16 DUCT JOINTS

A. All duct joints must be sealed airtight as required by Table 1-2 "SEAL CLASSIFICATION" of the "HVAC Duct Construction Manual". The term "seal" or "sealed" means use of mastic or mastic plus tape or gasketing as appropriate.

2.17 DIMENSIONS

A. Ducts, unless otherwise approved, shall conform accurately to the dimensions indicated on the drawings, and shall be straight and smooth on the inside with joints neatly finished. All duct sizes shown on the drawings are free area inside dimensions. Acoustically-lined ducts shall have outside dimensions increased as required to accommodate the acoustic lining specified and still maintain the free area inside dimensions shown on the drawings.

B. Under no circumstances shall the cross section of any duct be decreased by dents, pipes, or hanger rods running through it unless otherwise indicated on the drawings. Neither shall the shape be changed without approval. No abrupt transitions that restrict the area shall be used. Where necessary to gain clearance, the duct seams may be turned inside. Structural and Architectural drawings shall be consulted for areas with restrictive clearances.

2.18 FIELD VERIFICATION

A. No ductwork shall be fabricated without first field verifying that the available space (under actual job conditions) will permit installation of the ductwork without structural or other conflicts.

2.19 FLEXIBLE CONNECTION

A. This contractor shall provide flexible connections not less than 4 inches wide, constructed of heavy, waterproof, woven plastic-coated glass fabric at the inlet and outlet connections of each fan unit, securely fastened to the unit and to the ductwork by a galvanized iron band, and provided with tightening screws. Corners shall be sewn tight shut.

2.20 +4" PRESSURE CLASS FLEXIBLE CONNECTIONS

A. This flexible connection between the +4" P.C. ductwork and VAV boxes or fans shall be fabricated of neoprene-coated 1/8 inch glass fabric sheets with the ends vulcanized together. The flexible connection shall be securely attached to the fan and ductwork with heavy iron draw bands. Connections shall be 30-ounce Ventglass.

2.21 AIR FLOW MEASURING DEVICES

A. The sheet metal contractor shall install the air flow measuring devices as specified in Section 15900. The devices will be furnished by the control contractor.

2.22 BELT GUARDS

A. Belt guards shall be fabricated and installed. Guards shall be constructed of 10-gauge wire, 1-inch mesh in 1-1/2 inch angle-iron welded frames. All guards shall be provided with an opening for a tachometer and shall be either the split type or easily removable for belt repair. The guards shall be anchored securely to the floor or walls to prevent any vibration.

2.23 PRE-MANUFACTURED DUCTS

A. Runouts above ceiling from primary supply air ducts to VAV terminal boxes may be rigid conduit or pre-manufactured high pressure flex duct or a combination of the two.

B. Runouts above ceiling from the terminal boxes to the ceiling diffusers shall be similar to "Genflex - Type IL". Maximum allowance length is 5'-0" in any given duct run. Duct to be factory fabricated with spring steel wire helix and 1" thick glass fiber insulation covered with external vapor barrier and lined with continuous non-perforated inner sleeve.

C. Material shall comply with UMC Standard 10-1.

2.24 RECTANGULAR DUCT LINING

A. The interior surface of all rectangular supply, return, fresh, relief, and exhaust air ducts (except where noted otherwise), shall be lined with 1" thick fiberglass dual density duct liner, having an average "K" factor of .24 BTU at 75 deg. F mean. The liner shall meet standards NFPA No. 90A and No. 90B and shall have the Underwriters' Laboratories, Inc., label.

B. Duct liner shall be applied to the flat sheet with a 100% coverage of duct adhesive. The duct liner shall be cut to assure snug corner joints. The black surface of the liner shall face the air stream. On horizontal runs, tops of ducts over 12" in width and sides over 16" in height shall be additionally secured with welded pins and speed clips on a maximum of 15" centers. On vertical runs, gripnails or welded

pins and speed clips shall be spaced on a maximum of 15" centers on all width dimensions over 12". Pins shall start within 2" of all cross joints within the duct section.

C. Welded pins shall be cut virtually flush with the liner surface. Clips should be drawn down flush only and not so as to compress the liner and cause the leading edge of raise. All exposed edges and the leading edge of all cross joints of the liner shall be coated with adhesive.

D. Material shall comply with UMC Standard 10-1.

2.25 REGISTERS, GRILLES AND DIFFUSERS

A. Supply Air Registers: Furnish and install all supply air registers shown and specified on the drawings. All units to have opposed blade balancing dampers. Registers to have 4-way air deflection. All register cores shall be removable or plaster frames shall be furnished with units. Registers shall be of steel, or anodized aluminum construction. Finish shall be off-white unless otherwise noted. Units shall be Tuttle & Bailey, Carnes, Titus, Nailor, or Air Devices.

B. Return Grilles and Exhaust Registers: Furnish and install all ceiling and sidewall return grilles and exhaust registers shown and specified on the drawings. All units to be painted steel, or aluminum construction (where permitted by fire code) with opposed blade balancing dampers where specified. All cores shall be removable or plaster frames shall be furnished with units. Grilles or registers located near the floor shall be heavy duty gymnasium type. Units shall be Tuttle & Bailey, Titus, Nailor, Carnes or Air devices.

C. Ceiling Diffusers:

1. All ceiling diffusers shall be of the round, square, or rectangular type with louvered face and 1, 2, 3, or 4 way air pattern as indicated on the drawings. Units shall be painted steel, or aluminum construction (where permitted by fire code) with natural anodized finish and inner assembly shall be easily removable from outer frame without special tools. Louvers shall be spaced on 1-1/2" centers maximum.

2. All diffusers shall be furnished with round or square opposed blade volume control and air extractor. Diffusers shall be Tuttle & Bailey, Air Devices, Titus, Nailor, or Carnes.

D. General: Color and finish of all grilles, registers, and diffusers shall match ceiling grid. Coordinate with the Architect.

2.26 EXHAUST FANS

A. Roof-Mounted Type:

1. Furnish and install complete the quiet, low profile, roof-mounted exhaust fans of the size and capacity shown on the drawings.

2. Roof-mounted fans shall be of the centrifugal type with spun aluminum hood. All parts exposed to weather and all fastenings shall be either aluminum or stainless steel. All fans to be equipped with permanently lubricated two-speed (where specified) ball bearing motors located in separate compartment out of the air stream. Fan shall have adjustable V-belt drive, self-flashing insulated curb, backdraft dampers, birdscreen, disconnect switch, and shall be complete with all necessary fittings and transition pieces for a complete installation. All units shall bear the AMCA certified performance seal.

3. Fans shall be Cook, Greenheck, Penn, Ammerman, or Jenn-Air.

2.27 ROOF PENTHOUSES

A. Furnish and install complete the louvered roof penthouses shown on plans and specified in the Equipment Schedule. All units shall be rigid aluminum construction, with 4" type 'L' stormproof louvers, complete with birdscreen, reinforced self-flashing insulated base, color anodized finish, and all accessories required for a complete installation. Penthouses shall be designed and fabricated to withstand wind gusts of 150 MPH without physical damage.

B. Roof penthouses shall be Greenheck, Penn, or Titus.

2.28 VARIABLE AIR VOLUME RE-HEAT BOXES

A. Casings shall be 26 gauge galvanized with flange rectangular discharge duct connection. A one-piece aluminum backdraft damper shall be provided on the fan discharge. The damper shall be factory set and aligned to insure a precise seal. Leakage rate shall not exceed 2 percent of rated capacity at 0.5" static pressure.

B. Automatic damper operators and controllers shall be furnished by the ATC contractor and installed by the VAV box manufacturer.

C. The VAV box manufacturer shall furnish and install an approved cross flow sensor with a gain factor of not less than three (3).

D. VAV boxes shall be provided with a pressure independent volume regulator which operates thru a thermostatically reset velocity controller to provide constant air delivery within plus or minus 5 percent of rated flow, and down to 25 percent of the VAV box rated CFM. Factory calibrated field adjustable setpoints shall be provided to set maximum and minimum CFM.

E. The hot water heating coil shall be a single or multiple row unit as specified with

plate-type aluminum fins and mechanically bonded to a copper tube carrier pipe.

F. The entire unit shall be serviceable from a single ceiling access door.

G. The sound attenuators shall be 26 gauge galvanized steel construction with high density matt-faced insulation. Insulation shall be UL listed and meet all requirements of NFPA-90A.

H. Units shall be Tuttle & Bailey, Naylor, Trane, or Titus.

2.29 CROSS FLOW PRESSURE SENSORS FOR VAV BOXES

A. Sensors shall be aluminum corrosion resistant of the cross flow type with ported tubes and baffle mounted to a center manifold. The center manifold shall have 1/4" barb fittings for FRPE tubing, and shall provide a differential pressure proportional to the average velocity of air moving through duct.

B. The sensors shall have an amplification factor (gain) of at least three and flow coefficient as follows:

Size	Cv
4	209
5	315
6	462
7	612
8	817
10	1250
12	1792
14	2474
16	3235

2.30 AIR FILTERS

A. Provide one complete set of spare filter media (in addition to the new filters installed at time of acceptance) for each unit filter bank and store on site as directed by Architect.

B. Air filter banks shall be Cambridge, AAF, or Eco-Air.

2.31 HVAC SMOKE DETECTORS

A. All units above 2000 CFM shall be provided with smoke detectors located in the supply air discharge. Detectors to be provided and wired under Section 16000. ATC contractor to install all detectors.

2.32 COMBINATION FIRE/SMOKE DAMPERS

A. Furnish and install at locations shown on plans, combination fire-smoke dampers.

Frame shall be minimum 16 gauge galvanized steel formed from a continuous channel section. Bearings shall be formed in the frame and shall match the contour of the blade. Blades shall be roll formed single-thickness galvanized steel and shall overlap both frame and adjacent blades a minimum of 3/4". Blade edge and jamb seals shall be low friction type non-degradable steel-to-steel and shall withstand 850° F. with a minimum leakage of 15 cfm/ft. at 1" w.g. Stainless steel flexible metal compression type jamb seals will not be accepted. The torque required to maintain the rating in the closed position shall be 0 in-lbs. Blade linkage shall be interconnected to the damper jackshaft on both ends.

B. Each damper shall be rated per UL Standard 555, and shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL 555S. The leakage rating under UL 555S shall be no higher than leakage class II. Dampers shall be tested in HVAC systems to ensure operation with pressures of at least 4" w.g. in the closed position, and 4000 fpm in the open position. Each damper shall carry a UL label (File No. R11767) and a CSFM label (File No. 3225-368:008).

C. Actuators shall open upon loss of power and shall be rated to an elevated temperature of 250° F. Actuators which facilitate closing of the dampers shall be factory installed and shall be 120 volt electric and shall provide a minimum of 75 in-lbs. of torque at the damper shaft. Damper leakage shall provide for fail closed fire operation independent of the actuator position. Actuator bracket shall be designed to allow for the installation of ductmate without realignment or alterations. Manufacturer shall provide a factory assembled sleeve of 16 gage galvanized steel standard. Damper and actuator assembly shall be factory cycled to ensure proper operation. Dampers shall be installed in accordance with manufacturer's installation instructions. Suitable access shall be provided for inspection and servicing of each damper.

D. Electro-Thermal Bi-Metallic Link (resettable) - Each damper assembly shall be equipped with a UL 33 listed electro-thermal bi-metallic resettable 'McCabe Link' that provides for fail closed fire and smoke operation independent of the actuator position, electric sensing stats will not be accepted. Electro-thermal McCabe link shall disengage damper linkage from actuator and mechanically lock damper in a closed position from either a smoke detector signal or when duct temperature exceeds 250° F. (shall not exceed operational limit of actuator). The design shall only allow damper to be reopened when the smoke detector signal is clear and the duct temperature has returned to a safe level, as per NFPA 92A. Damper assembly shall include dual position indicator switch package capable of positively indicating each damper's status as being full-open or full-closed at remote central control panel. Actuator shall be fail open upon loss of power. Dampers shall be Pottorff Model 5010 with PI-50 dual position indicating switch package.

E. Provide hinged, gasketed, and latched access panels in duct at each damper. Stencil "Fire Damper" in 1" high red letters on white background at each access

panel.

F. Provide ceiling access panels approved by the Architect at each duct access panel when required, for maintenance and inspection of the fusible link.

G. Combination fire/smoke dampers shall be Pottorff Series 5000, Air Balance, PreFlo, or Nailor Hart.

2.33 DAMPERS - GENERAL

A. Damper frames shall be of not less than 13 gauge galvanized steel, formed for extra strength, with mounting holes for enclosed duct mounting.

B. All damper blades shall be of not less than 16 gauge galvanized steel formed for strength and high velocity performance. Blades on all dampers must be of not over 6" in width. Blades shall be secured to 1/2" diameter zinc-plated axles by zinc-plated bolts and nuts. All blade bearings shall be nylon. Blade side edges shall seal off against spring stainless steel seals. Teflon-coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and insure smooth operation. All blades linkage hardware shall be constructed of corrosion-resistant, zinc-plated steel and brass.

2.34 AUTOMATIC DAMPERS

A. The ATC contractor shall furnish all automatic control dampers. The sheet metal contractor shall install all dampers and transition all ductwork to the dampers.

2.35 AIR CONDITIONING UNITS:

A. Furnish and install complete the packaged wall mounted air conditioning units of the size and capacity shown and specified on the drawings.

B. Indoor unit

1. Indoor unit shall be of the slim-line design for surface mounting with rugged steel casing and baked enamel finish with front outlet grille with swing flow louvers for air stream adjustment. Blowers shall be high performance Sirocco type with variable speed motors and controls. Unit shall have DX cooling. Cooling coil shall have drip pan with drain connection. Unit shall be complete with high level condensate cut-off switch. Air filters shall be washable media type removable from behind the return air grille in the unit casing.

2. Indoor unit shall be furnished with remote control thermostat for field mounting.

3. Indoor unit shall be EMI, Mitsubishi, or Carrier.

C. Outdoor unit

1. Outdoor unit shall be compact design, side outlet, with hermetic compressor, crankcase heater, high and low pressure safety cut-outs, low ambient control to -20° F., suction line accumulator, compressor overload protection, condenser coil with high performance condenser fans, weather-proof housing and all controls for automatic operation.

2. Air conditioning unit shall have an EER of 6.1 or greater, and a COP of 1.8 or greater.

3. Outdoor unit capacities and characteristics shall be matched to the indoor unit it serves.

4. Unit shall be EMI, Mitsubishi, or Carrier.

PART 3 - EXECUTION

3.1 JOB SITE CONDITIONS

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that the work of this section may be installed in accordance with all pertinent codes and regulations in the approved shop drawings.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Owner.

2. Do not proceed with installation in areas of discrepancy, until all such discrepancies have been fully resolved.

3.2 INSTALLATION OF EQUIPMENT

A. Install all equipment with adequate space for service and maintenance.

B. VAV boxes, fan coil units, and similar equipment which requires periodic service and maintenance shall be installed in plenum space within 2 ft. of finished ceilings, or within 2 ft. of the bottom chord of the structure.

C. All visible surfaces behind grilles and registers shall be painted flat black.

D. Care shall be taken to avoid interference with structure and the work of other trades. Do not cut into load carrying members without the approval of the Architect.

3.3 INSTALLATION OF DUCTS

A. All ducts shall be installed in compliance with the latest editions of the SMACNA manuals.

B. All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All changes, however, must be approved and installed as directed.

C. Pre-manufactured ducts shall be connected to rigid ducts and equipment with the solid wraps of fabric duct tape and tyton bands drawn tight to form an airtight joint.

D. During the installation, the open ends of all ducts shall be protected by covering with plastic sheet tied in place to prevent debris and dirt from entering.

E. Install this work in cooperation with other trades so that there will be no delay in progress of construction work. It is extremely important that the duct system be clean before connections are made to the VAV boxes.

F. The contractor shall take special care when running exposed ductwork to insure that the final installation is neat in appearance.

G. Under no circumstances shall ductwork be supported from the metal roof deck.

H. Ceiling outlets shall be rigidly supported from the overhead structure with G.I. wires or straps, or from rigid galvanized iron ductwork. Outlets shall not be supported from T-bar ceilings or metal roof deck.

3.4 STORAGE OF DUCTS

A. Ductwork shall be stored in a protected area to prevent physical damage to the duct liner, and to insure that the duct liner is not exposed to excessive heat or moisture which would deteriorate the air side surface.

B. Ductwork which has been improperly stored and/or sustained physical damage will be rejected, and shall be removed from the job site as directed by the Architect.

3.5 CLEANING OF DUCTS

A. Before ducts are insulated and before the ceiling is installed and final connections made to the terminal boxes, the fans shall be operated at full capacity to blow out any dirt and debris from ducts. If it is not practical to use the main supply blower for this cleaning, the ducts may be blown out in sections by a portable fan. After the ducts have been cleaned and initially pressure tested, the final connection shall be made to the terminal boxes.

3.6 TESTING OF DUCTS

A. Supply, return, and exhaust ducts, plenums, and casings operating at duct pressures from +2" to -2" shall be tested and made substantially airtight at static pressure indicated for the system before covering with insulation or concealing in masonry. Substantially airtight shall be construed to mean a leakage rate less than 5% of the rated airflow.

B. Supply air ducts operating at pressures above +2" shall be tested and made substantially airtight. Leakage shall be less than 1% of the rated air flow.

C. Ducts including all flexible runouts shall be tested in accordance with SMACNA Duct Construction Standards.

D. After the vertical duct risers or branch ducts have all been tested and tied into the mains, and after the central station air handling apparatus has been installed, the mains shall be tested in accordance with SMACNA Duct Construction Standards.

END OF SECTION 15800.

SECTION 15900 - AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

A. All pertinent sections of this specification may be part of the work described in this section. This contractor will require coordination of other trades. This contractor will have a project manager, with not less than five years experience, on site when ATC work commences to coordinate daily work activities.

1.2 SCOPE OF WORK:

A. The scope of work shall include all labor, material, and equipment necessary to complete the temperature control work for the entire project.

B. The Contractor under this heading shall furnish and install a complete direct digital control system as specified.

C. The temperature controls shall be installed and certified by a representative of Control Systems International manufacturer, as an n extension of the existing DDC system. The installer must have been in business for at least ten years, and have a valid electrical license for the State of Utah. Install a new TAC/CSI Direct Digital Control (DDC) system to be tied into the existing TAC/CSI Host Computer located at the maintenance. This system shall include, but not are limited to, controls and equipment as hereinafter specified:

Air Handler Unit ‘AH-2’
Air Cooled Chiller ‘CH-2’
VAV reheat boxes
Roof Mounted Exhaust Fans
VAV with Radiant Heat
Fan Coil Unit ‘FC-1’
Split System A/C unit ‘AC-2’

1.3 WORK TO BE PERFORMED BY OTHERS

A. The Contractor shall carefully review all notes, coordination schedules, and drawings for work required under this section of the specification.

B. Division 16 shall furnish and install all single phase and multiple phase electrical power wiring to magnetic starters, disconnect switches, and motor. Division 16 shall also provide 120 power to each ATC panel. ATC contractor shall be responsible for step down transformers and 24 VAC wiring to ATC equipment.

C. The sheet metal contractor shall install all dampers supplied by the ATC contractor. Each damper shall be installed so that it will operate freely and without binding. Each damper shall be checked and those not properly installed shall be replaced or reinstalled without cost to the ATC contractor.

1.4 RELATED WORK:

A. Mechanical Contractor to install all control valves, wells for temperature sensors, and this contractor to supply location and temperature sensors wells.

1.5 ELECTRICAL WIRING:

A. A licensed electrical contractor shall install all wiring. All power wiring to control panels will be done by division 16 contractor. The ATC Contractor is responsible for all control wiring. All wiring shall be installed in conduit and in accordance to the National Electrical Code and local codes.

1.6 SUBMITTALS:

A. Prior to any installation, the Contractor shall submit, with 30 days after award of contract, a complete submittal package. This submittal shall contain six (6) copies of complete literature on all control equipment including control diagrams as per the sequence of operation.

1.7 SEASONAL ADJUSTMENTS:

A. Seasonal adjustments to the control system will need to be included in this bid. Depending on the finish date this contractor will schedule 8 hours, with maintenance personal to check the system in the mode of either winter conditions or summer.

1.8 PROJECT MANAGEMENT:

A. Provide a designated project manager who will be responsible for the following:
1. Construct and maintain project schedule
2. On-site coordination with all applicable trades and subcontractors
3. Attend project meetings
4. Make necessary field decisions

1.9 WARRANTY:

A. Provide all services, materials and equipment necessary for a one-year period after beneficial use has been established.

1.10 TRAINING:

A. Training will consist of a total of 8 hours. Classes will be broken into 8-hour sessions at the owner's desecration. Owner to provide one week notice of when they would like these sessions.

PART 2 - PRODUCTS AND EQUIPMENT

2.0 MANUFACTURERS

A. Provide a new stand alone TAC/CSI Direct Digital Control (DDC) system. DDC system shall be compatible with and tied into the existing network via Net plus Routers. System to be installed programmed and commissioned by TAC/CSI factory authorized personal only.

2.1 VALVES:

A. ATC valve bodies 2" and smaller shall be screw type; larger valves shall be flanged. Screwed valves shall be rated at 150 psi or greater and shall have cast iron or brass bodies. Flanged valves shall be rated at 250 psi or greater and have cast iron or steel bodies. All automatic valves shall be for DDC control application. All valves shall be disc/plug and seat or ball construction. Valves to be sized for a 3-lb. pressure drop.

2.2 DAMPERS:

A. The ATC contractor shall furnish motorized control dampers that are not supplied with the air handling units. All dampers shall be factory-built, low leakage units such as Ruskin CD-50 or approved equal. Blades shall be 6" maximum width; material to be extruded aluminum, and blade linkage to be external and accessible.

B. Frames shall be 5" x 1" and made of extruded aluminum hat channel, 0.125" minimum thickness with corner braces to assure that they are square.

C. Dampers shall be low leakage type with compressible end seals and neoprene of extruded vinyl blade and jamb seals. Leakage shall be not exceed 6.2 cfm/sq. ft. at 4" W.G. Dampers shall require less than 7#-in/sq. ft. torque at the operating shaft.

2.3 BUILDING MANAGEMENT SYSTEM (BMS):

A. The TAC/CSI system is existing, and shall be extended to the new equipment.

2.4 LOCAL AREA NETWORKS (LAN):

A. Controller LAN: The FMS shall provide communication between the DCU's over a Local Area Network (LAN).

B. The Controller LAN shall be a "bus type" network over which information is transmitted in a "token passing" fashion between all the nodes on the network.

C. The Controller LAN shall have the capacity to contain not less than 64 nodes as a minimum. Each work station, DCU, or "gateway" device shall represent a node to the network.

D. The Controller LAN shall connect the nodes in a fully distributed environment, each DCU operating autonomously while communicating with all other nodes on the network. Controller LANs requiring a communication controller (for any reason) will not be acceptable. LAN lengths in excess of 24,000 ft. shall be supported.

E. A break in the communication path of the Controller LAN shall be announced as an alarm and shall automatically initiate a Controller LAN reconfiguration such that the resulting sections of the Controller LAN continue to function as separate LANs. No loss of control shall result from such a break in the Controller LAN.

F. Commercial LAN: Workstations on the Controller LAN may also reside on a higher tier "commercial" LAN. This "commercial" LAN shall be based on Ethernet, and comply with IEEE 802.3 standards. Where a "commercial" LAN is implemented, it shall be possible to connect multiple Controller LANs together, with global data sharing across this commercial LAN.

G. Data speed shall not be less than 10 Megabaud.

H. An operator at a workstation on the "commercial" LAN may connect to any other workstation on the "commercial" LAN as if the operator were sitting at the other workstation.

I. Alarms and special event notices shall be routed to different workstations on the "commercial" LAN based on time of day, and day of the week.

J. Operator password assignment shall be available on both a system-wide basis and a workstation by workstation basis.

2.5 DIRECT DIGITAL CONTROL SYSTEM-OVERVIEW:

A. The direct digital control system shall consist of local microprocessor-based digital control panels (DCP) network together for information sharing and operating convenience and a central operator interface station.

B. It is the intent of these specifications to create a combined direct digital control system. All system type control functions, such as those used for fan systems, boilers, chillers, central plant and pumps, building pressure, etc., shall be accomplished by using software algorithms in the respective DCP.

C. Each major mechanical component (fan system, chiller, boiler, etc.) shall have its own dedicated DCP so that failure of any will not result in catastrophic system failure. DCP's utilizing a master-slave relationship shall have a master unit provided for each major mechanical system.

D. All safety devices such as fire alarm shutdown, smoke detectors, low limit thermostats, etc., shall be hard wired to accomplish their critical functions completely independent of the DCP and shall have additional outputs as required to sever as inputs to the DCP for secondary control and reporting functions.

2.6 CONTROLLER (DCU):

A. The controller shall be a microprocessor and shall form the basic control unit of the system. It shall operate as a stand-alone unit providing all the necessary algorithms and software logic to perform the local HVAC control sequences and energy saving functions. Failure of any one DCU shall have no effect on the other DCU's in the system. Programming shall be block type and accomplished by the operator's terminal, or the remote operator terminal. The DCU shall have the ability for direct digital control; automatic time scheduling; demand limiting; calculated points universal inputs with configurable outputs; an RS-485 Lan port; an RS-232 port; an TTL port for hand held console; trend sampling, and on line editing capability. The controller shall operate independent of any central computer, shall have built in diagnostic routines, and shall have 72-hour battery back up.

B. Inter-computer communications shall support true global token passing control strategies as well as allow data status and values connected to one DCU to be used within application programs of another DCU.

C. The system shall provide a network communication facility to support global calculation and control strategies to be continuously implemented in the distributed system. The system shall provide for events detected in any area of the total network to initiate commands to any other device within the network. The system shall also provide for connected or calculated data to be continuously shared between any or all controllers within the total network. Through the DCU's may share none critical sensor information, at no point within the facility shall quick reacting and constantly changing point information be communicated via the network bus. These types of point shall be hardwired to the DCU in which the algorithm exists.

2.7 SOFTWARE:

A. This contractor should provide the most current versions of all-necessary controlling & monitoring software & graphic displays shall be installed. These shall include but not be limited to Microsoft Windows 98, DDC operating system and data files.

B. Copies of all software releases available within one year of the substantial completion shall be provided and installed to the owner at no cost.

2.8 AIR DUCT SMOKE DETECTORS:

A. Smoke detectors shall be furnished and wired by Division 16. The electrical contractor shall interlock all smoke detectors with the building fire alarm system.

2.9 TEMPERATURE SENSORS:

A. Provide thermistor or thin film silicon sensors for all temperature applications, except differential chilled water for BTU calculation, where precision matched Platinum RTDs shall be used. Solid state sensors shall be linear, drift free, and require only a one-time calibration. A look-up table in the connected controller shall linearize thermistors or similar non-linear temperature devices. Resolution shall be better than .5 degrees F for Micro Controller applications, and better than .2 degrees F for DCP applications.

B. Space sensors shall have an integral port for connection of a portable “intelligent” sensor to communicate with its DCP. This port and portable “intelligent” sensor may be used for initiating the "test mode" locally to verify all DCP control sequences, and perform test and balancing functions. To eliminate the downtime associated with rechargeable batteries, the portable “intelligent” sensor shall receive its power from the sensor port.

PART 3 - SEQUENCE OF CONTROL

3.0 GENERAL:

A. All settings specified below are initial settings only and must be field adjusted to satisfy actual job site conditions.

3.1 VAV FAN SYSTEM (AH-2):

A. The VAV fan system each consist of a supply fan driven by a VFD, a heating coil with coil re-circ pump, a cooling coil, filters and outdoor air, and return air dampers.

B. The supply fan shall be started from a local DDC controller through a HAND-OFF-AUTO switch, located on the face of the VFD bypass panel

C. In HAND position the fan shall operate continuously, in OFF position the fan shall be stopped, and in AUTO position the DDC system shall in the Occupied mode an enable the fan to run according to the sequence, and cycle to maintain min.

space temperature when in the UNOCCUPIED mode.

D. Fan system shall be subject to freezestat building fire alarm, supply duct high static pressure, building optimal start-stop programs, and other conditions or logic pro-programmed into the DDC controllers.

E. If the fan system is shutdown or fails to start due to abnormal conditions, an alarm shall be sent to the DDC system. When the fan is stopped under any condition, the outside air damper and relief air dampers shall close.

F. A manual reset, high limit pressure switch sensing supply duct static pressure within the fan room shall shut down the fan and alarm the DDC system if its 3” w.c. setting is exceeded.

G. A differential pressure switch with its static pressure tips located across each fan system filter bank shall provide the DDC system with the status of each filter bank. An alarm shall be supplied to the DDC system whenever the filter differential pressure remains above 0.35 w.c. for more than 15 continuous minutes (adjustable).

H. OCCUPIED mode: A supply air temperature sensor and an outdoor air temperature sensor, acting through DDC controllers, shall modulate the heating coil pump and valve, outdoor air, return air dampers, and cooling coil to maintain supply air temperature according to the following schedule:

Outdoor Air Temperature	Supply Air Temperature
55 deg. F	55 deg. F
10 deg. F	65 deg. F

I. Whenever heating valve is not closed or when outdoor air temperature exceeds 76 deg. F, the outside air dampers shall close to the minimum position as determined by the return duct air quality transmitter and minimum ventilation requirements.

J. A 0-5” w.c. Supply duct static pressure transmitter with its static tip located 2/3 of the way down the supply duct and acting through a DDC controller shall modulate supply fan speed to maintain 1” of supply duct static pressure.

K. An air quality transmitter located in the return air duct, acting through a DDC controller, shall reset the outside air damper minimum position. The amount of reset action shall be adjustable and subject to a maximum of 26% minimum outdoor air. Air quality sensor shall be capable of maintaining a minimum of 800 to 900 ppm of C02.

L. A mixed air temperature sensor, acting through a DDC controller, shall provide 48 deg. F mixed air temperature low limit control of the air handing system. If mixed air temperature drops below 39 deg. supply fan shall stop, outdoor air dampers shall close and an alarm shall be sent to Host Computer.

M. Outdoor air dampers shall remain closed when building is unoccupied. Outside air dampers shall open at precise time of occupancy.

N. UNOCCUPIED mode: A space temperature sensor, acting through a DDC controller, shall cycle the supply fan with the heating pump and valve open 100% to maintain desired minimum space temperature. Outdoor air dampers shall remain closed. Chilled water valve shall close to the coil when the supply fan is not running.

3.2 FIRE ALARM FAN SHUTDOWN:

A. All heating, ventilating and air conditioning system supply fans shall automatically shut off when the building fire alarm system is energized. All fans to automatically start up again when fire alarm system is reset. Fire alarm system fan relays shall be “normally energized” and shall be installed by Division 16 at each fan system.

3.3 CHILLED WATER SYSTEM CONTROL:

A. The chilled water system consists of two air-cooled, multi-compressor chiller and chilled water pumps with VFD’s.

B. This system consists of two chilled water pumps. They will operate on a lead-lag basis through the building DDC system. The lag pump shall be changed to the lead pump every 7 days. If the lead pump does not start when command to do so after 60 seconds, the second or lag pump shall start and an alarm shall be sent to the DDC system.

C. When the building is in OCCUPIED mode and outdoor air temperature is above 60 deg. F, the chilled water system shall be activated.

D. When building control system turns chillers off chilled water pumps shall run for an additional 5 minutes.

E. A flow switch in the chilled water line and interlock with the chillers as recommended by the chiller manufacturer.

F. The chillers shall be supplied with factory furnished controls. Once enabled by the DDC system, chiller shall operate by its own control system.

G. Analog current transmitters shall monitor the status of all heating and cooling water pumps.

3.4 VAV BOX CONTROL W/ REHEAT COILS:

A. A VAV box-mounted DCC controller shall be provided for control and operation of each VAV box and reheat coil. A room sensor shall be mounted on the wall to

sense space temperature, so the DDC controller can modulate the box primary air damper between minimum ventilation position and maximum designed airflow and position to reheat coil valve in sequence to maintain the desired space temperature. Heating and cooling setpoints and minimum and maximum CFM shall be individually adjustable from the man-machine interface device.

B. Reheat coil control valves shall be 2-way or 3-way configuration, and the actuator shall be proportional. Johnson Controls, Barber Colman, Belimo, or Honeywell shall manufacture valve and actuator.

C. Each VAV box DCC controller shall have a 24 volt power connection with all 24 volt control wiring by the ATC contractor.

3.5 RADIANT PERIMATER HEATING:

A. Radiant heating located in certain areas of the building shall have two-position valves, and open on a call for heating. A DDC Thermostat shall monitor the heating set point and open and close the valve accordingly.

B. The radiant heating shall be sequenced with the VAV reheat box serving the same area.

3.6 FAN COIL UNIT CONTROL (FCU-1):

A. In the occupied mode DDC system shall enabled the fan coil unit to run based on the space temperature sensor, and shall modulate heating coil valve to maintain desired space temperature. Fan shall run continuously when outdoor air temperature is below 55 deg. F.

B. During Unoccupied mode, fan shall cycle to maintain desired minimum space temperature.

3.7 GENERAL EXHAUST FAN (EF-6)

A. The new roof mounted exhaust fan shall be enabled through the DDC system by a pre-determined time schedule.

3.8 PACKAGED SPLIT SYSTEM AIR CONDITIONING UNIT (AC-2)

A. This contractor shall install, wire, and calibrate the controls furnished with the small split system air conditioning unit.

3.9 ELEVATOR EQUIPMENT ROOM

A. Relocate existing elevator room motorized damper control.

END OF SECTION 15900.

SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

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. Supporting devices for electrical components.
2. Earthwork.
3. Cutting and patching for electrical construction.
4. Touchup painting.
5. Permits and Fees

1.3 SUBMITTALS

A. Submittal Procedures: Submittal procedures are specified in Division 1.

1. Prepare submittals in three-ring “hard cover” binders with project name and volume on the binding. Include tabs identified by the specification section and in numerical order. Include plastic sleeves to hold drawings that exceed 8-1/2” x 11”.

B. Project Record Documents: Project Record Documents are specified in Division 1.

1. Redline changes or information recognized to be of importance to the Owner. Include wiring changes, panelboard changes, etc.
2. Dimension underground wiring and other concealed electrical features.
3. Redline actual equipment electrical characteristics on equipment schedules.

C. Digital Operation and Maintenance Manual on CD-ROM

1. Intuitive CD-ROM instructional manual for information to care, adjust, maintain and operate equipment. Include contract documents, shop drawings, product data.

a. Software: Adobe Acrobat.
b. Format: PDF.
c. Index: Hypertext alphabetical index.
d. Auto Starting: Windows 9X with any directions to continue observable on the screen.

1.4 QUALITY ASSURANCE

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A. 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.

B. Comply with NFPA 70.

C. Comply with Owner Standards.

1. State of Utah, Division of Facilities Construction and Management "Design Criteria".

D. Installer Qualifications: All workmen doing electrical work shall be duly licensed with the required supervision in the State or Locality as legally required.

1. Site Review: All electricians must carry their electrician's license with them and show it upon request.

1.5 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical equipment installation with other building components.

1. Verify all dimensions be field measurements.
2. Minimize costs to resolve equipment and other conflicts by successfully concluding preinstallation conferences. Include the following:

a. Review Division 15 shop drawings. Compare equipment electrical specifications with equipment schedule. Prevent Div 15 equipment encroaching on clearances required by NEC. Request clarification of conflicts prior to installation.
b. Determine whether lighting fixtures and other electrical items conflict with the location of structural members and mechanical or other equipment.
c. Coordinate connecting electrical service to components furnished in other sections of the specification or by the User. Verify electrical requirements including voltage, full load amps, and minimum wire ampacity prior to installing or purchasing the associated electrical equipment and wiring.
d. Review systems furniture electrical specifications and compare with wiring indicated. Request dimensional layout from furniture installer including electrical connection locations. Request clarification of conflicts prior to installation.

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D. Coordinate electrical service connections to components of Owner's facilities.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of Owner providing electrical power and other services.
3. Notify Architect a minimum of seven days in advance of any proposed utility interruption and obtain approval prior to proceeding. Comply with requirements of the Owner, User, and Utility.
4. Include all costs, including Owner, municipal or utility costs that will need to be paid to reroute primary electric service as shown on the site electrical plan.

E. Coordinate communication service connections to components of Owner's facilities.

1. Coordinate installation and connection of exterior underground and overhead utilities and services.
2. Comply with requirements of authorities having jurisdiction.
3. Notify Architect a minimum of seven days in advance of any proposed utility interruption and obtain approval prior to proceeding. Comply with requirements of the Owner, User, and Utility.

F. Coordinate with Authorities Having Jurisdiction including: city, county, state, university, federal and other governmental authorities.

1. Obtain all permits (including excavation permits) prior to beginning construction.
2. Pay all fees.
3. Request inspections required by Authorities Having Jurisdiction in a timely manner and in order to comply with sequencing requirements.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.

1. Channel Thickness: Selected to suit structural loading.
2. Fittings and Accessories: Products of the same manufacturer as channel supports.

D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

E. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

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F. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.

G. Expansion Anchors: Carbon-steel wedge or sleeve type.

H. Toggle Bolts: All-steel springhead type.

I. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. For Nonequipment Surfaces: Matching type and color of undamaged, existing adjacent finish.

C. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

E. Existing Utilities: Locate and identify existing underground utilities in excavation areas or in demolition areas. Maintain services to areas outside demolition limits or excavated areas. When services must be interrupted, install temporary services for affected areas.

F. Manufacturer’s Instructions: Comply with manufacturer’s installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements indicated in the Contract Documents.

G. Record drawings and Shop Drawings: Mark up drawings daily during construction with changes or deletions in the scope of the project.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

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A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

1. Comply with NFPA 70. In addition, install supports within 12" of couplings, fittings, and boxes, with a minimum of two supports per 10 foot length. Install supports at each change of direction.
2. Support suspended conduit independently from all other electrical or mechanical systems by attaching directly from building structure, unless prior approval in writing has been obtained from the Architect after engineering calculations have been submitted.
3. Coordinate installation of supports so as not to interfere with the removal of ceiling tiles, the service of mechanical equipment, etc.
4. Install bracing parallel to trusses, beams, joists, bridging, etc.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

H. Simultaneously install vertical conductor supports with conductors.

I. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar

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hangers. If supported directly from the building structure, attach box to framing on opposite sides of the box. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.

J. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

K. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

1. Install wrapped or coated RMC sleeves with 3 feet extending on each side through penetrations of foundations or concrete walls by RNC.

L. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Wood: Fasten with wood screws or screw-type nails.
2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
3. New Concrete: Concrete inserts with machine screws and bolts.
4. Existing Concrete: Expansion bolts. Drill holes in concrete so holes do not cut main reinforcing bars. Fill and seal holes drilled in concrete and not used.

   a. Obtain prior approval from project structural engineer prior to drilling prestressed or post-tension concrete slabs and beams.

5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
6. Steel: Welded threaded studs or spring-tension clamps on steel.

   a. Field Welding: Comply with AWS D1.1.

7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
8. Light Steel: Sheet-metal screws.
9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load. Do not support electrical equipment or conduits with toggle bolts, moly-bolts, or screws in sheetrock or plaster. Do not support electrical equipment or conduit from tie wires.
10. Do not use wooden plugs in concrete or masonry units for fastening conduits, tubing, boxes, cabinets, etc.

3.4 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

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3.5 EARTHWORK

A. Excavating, filling, and grading: Provide for all electrical site work shown on the site plan.

B. Fill: Backfill for underground raceways (not concrete encased) in roadways or parking lots with concrete encased slurry (1 bag mix). Backfill underground raceway (not concrete encased with sand 6" above and below in other than roadways or parking lots.

C. Remove rubbish, waste, and excess soils.

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

1. Relocate existing electrical devices, conduit or equipment that for any reason obstructs construction. Include any equipment having electrical connections that requires disconnecting and reconnection at the same or another location throughout the course of construction.
2. Maintain in working condition all electrical equipment and apparatus in areas not remodeled.
3. Temporary Partitions or Dust Barriers: Prevent the spread of dust and dirt to adjacent areas.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

1. Include exposed equipment and installations made obsolete by new work.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove and legally dispose of demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

F. Remove conductors from raceway to the first active outlet or branch panels for vacated or unused circuits.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

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1. Core drilling: X-Ray post-tension slabs prior to core drilling to assure that post-tension cables are not damaged.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.8 FIELD QUALITY CONTROL

A. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.
2. Electrical demolition.
3. Cutting and patching for electrical construction.
4. Touchup painting.

B. Test all electrical work to ensure that they test free of mechanical and electrical defects.

1. Comply with testing requirements of authorities having jurisdiction.
2. Comply with Owner's standards for testing in documents listed in "Quality Assurance".

3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

1. Remove labels that are not permanent labels.
2. Wipe surfaces of electrical equipment. Remove excess lubrication and other substances.
3. Clean exposed exterior and interior hard-surface finishes to a dust-free condition, free of stains, films and similar foreign substances.

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B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 16050

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SECTION 16060 - GROUNDING AND BONDING

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 grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Ground bus.

B. Field Test Reports: Submit written test reports to include the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 QUALITY ASSURANCE

A. 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.

1. Comply with UL 467.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grounding Conductors, Cables, Connectors, and Rods:
   a. Apache Grounding/Erico Inc.
   b. Boggs, Inc.
   c. Chance/Hubbell.
   d. Copperweld Corp.
   e. Dossert Corp.
   f. Erico Inc.; Electrical Products Group.
   g. Framatome Connectors/Burndy Electrical.
   h. Galvan Industries, Inc.
   i. Harger Lightning Protection, Inc.

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j. Hastings Fiber Glass Products, Inc.
k. Heary Brothers Lightning Protection Co.
l. Ideal Industries, Inc.
m. ILSCO.
n. Kearney/Cooper Power Systems.
o. Korns: C. C. Korns Co.; Division of Robroy Industries.
p. Lightning Master Corp.
q. Lyncole XIT Grounding.
r. O-Z/Gedney Co.; a business of the EGS Electrical Group.
s. Raco, Inc.; Division of Hubbell.
t. Robbins Lightning, Inc.
u. Salisbury: W. H. Salisbury & Co.
v. Superior Grounding Systems, Inc.
w. Thomas & Betts, Electrical.
x. VFC, Inc.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."

B. Material: Copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.

E. Grounding Electrode Conductors: Stranded cable.

F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.

G. Bare Copper Conductors: Comply with the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

H. Copper Bonding Conductors: As follows:
1. Bonding Conductor: as noted on the drawings, stranded copper conductor. Comply with NEC minimum requirements.
2. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (42 mm) wide and 1/16 inch (1.5 mm) thick.

I. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

1. 2” X 12” X ¼” minimum ground bus mounted on insulators.

2.3 CONNECTOR PRODUCTS

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A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 - EXECUTION

3.1 APPLICATION

A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

B. In raceways, use insulated equipment grounding conductors.

C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

1. Use for interconnecting wiring from ground bus to ground bus.

D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.

E. Grounding Bus: Install in LAN and telephone equipment rooms..

1. Use 2” X 12” X ¼” bus with insulated spacer; space 2 inch (50.8 mm) from wall. Locate 12” above floor, unless otherwise indicated.

F. Underground Grounding Conductors: Use tinned- copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade or bury 12 inches (300 mm) above duct bank when installed as part of the duct bank.

3.2 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and branch wiring.

C. Isolated Grounding Receptacle Circuits: Install an insulated equipment-grounding conductor connected to the receptacle-grounding terminal. Isolate grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

D. Nonmetallic Raceways: Install an equipment-grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

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E. Air-Duct Equipment Circuits: Install an equipment-grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

F. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment-grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

G. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6.4-by-50-by-300-mm) grounding bus.

3.3 INSTALLATION

A. Renovation Projects: Document existing ground system at the main service and at each separately derived system serving the renovated area. Correct deficiencies of existing grounding system that do not comply with requirements of this section.

B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

D. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

E. Metal Frame of the building where effectively grounded: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to metal frame of building. Exothermically weld grounding conductors to metal frame. Bond metal grounding conductor conduit or sleeve to conductor at each end.

F. Concrete encased steel reinforcing bar or rod in underground footings or foundations: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to reinforcing bar or rod. Exothermically weld grounding conductors to reinforcing bar or rod. Bond metal grounding conductor conduit or sleeve to conductor at each end.

3.4 CONNECTIONS

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A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Non-contact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 SEPARATELY DERIVED SYSTEMS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of grounding electrode conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Do not ground system neutral conductor under any circumstances after it has been grounded at the service entrance disconnect except for separately derived systems. Interconnect or bond all grounding systems to the main system ground. Do not used

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neutral conductors for grounding equipment. Do not bond the neutral bus to distribution cabinets, except for separately derived systems.

3.6 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

   a. Equipment Rated 500 kVA and Less: 10 ohms.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.7 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 16060

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SECTION 16071 - SEISMIC CONTROLS FOR ELECTRICAL WORK

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 seismic restraints and other earthquake-damage-reduction measures for electrical components. It complements optional seismic construction requirements in the various electrical component Sections.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. Seismic Restraint: A fixed device (a seismic brace, an anchor bolt or stud, or a fastening assembly) used to prevent vertical or horizontal movement, or both vertical and horizontal movement, of an electrical system component during an earthquake.

C. Mobile Structural Element: A part of the building structure such as a slab, floor structure, roof structure, or wall that may move independent of other mobile structural elements during an earthquake.

1.4 SUBMITTALS

A. Product Data: Illustrate and indicate types, styles, materials, strength, fastening provisions, and finish for each type and size of seismic restraint component used.

1. Anchor Bolts and Studs: Tabulate types and sizes, complete with report numbers and rated strength in tension and shear as evaluated by ICBO Evaluation Service.

B. Shop Drawings: For anchorage and bracing not defined by details and charts on Drawings. Indicate materials, and show designs and calculations signed and sealed by a professional engineer.

1. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
2. Details: Detail fabrication and arrangement. Detail attachment of restraints to both structural and restrained items. Show attachment locations, methods, and spacings, identifying components and listing their strengths. Indicate direction and value of forces transmitted to the structure during seismic events.
3. Preapproval and Evaluation Documentation: By ICBO Evaluation Service, showing maximum ratings of restraints and the basis for approval (tests or calculations).

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C. Product Certificates: Signed by manufacturers of seismic restraints certifying that products furnished comply with requirements.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results of seismic control devices for compliance with requirements indicated.

1.5 QUALITY ASSURANCE

A. Comply with seismic restraint requirements in IBC, unless requirements in this Section are more stringent.

1.6 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural system and architectural features, and with mechanical, fire-protection, electrical, and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. B-Line Systems, Inc.
3. Erico, Inc.
4. GS Metals Corp.
5. Loos & Company, Inc.
6. Mason Industries, Inc,
7. Powerstrut.
8. Thomas & Betts Corp.
9. Unistrut Corporation.

2.2 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

2.3 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to authorities having jurisdiction.

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1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.4 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch (41-by-41-mm) cross section, formed from 0.1046-inch- (2.7-mm-) thick steel, with 9/16-by-7/8-inch (14-by-22-mm) slots at a maximum of 2 inches (50 mm) o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 570, GR 33.
2. Materials for Fittings and Accessories: ASTM A 575, ASTM A 576, or ASTM A 36.
3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
2. Wire Rope Cable: Comply with ASTM 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Install seismic restraints according to applicable codes and regulations and as approved by authorities having jurisdiction, unless more stringent requirements are indicated.

1. Install bracing parallel to trusses, beams, joints, bridging, etc.

B. Install safety wires fastened to structure at diagonal corners of lighting fixtures for seismic support of fixtures mounted in or on grid type ceilings. Do not fasten to grid hangers or to grid hanger's point of support.

3.2 STRUCTURAL ATTACHMENTS

A. Use bolted connections with steel brackets, slotted channel, and slotted-channel fittings to spread structural loads and reduce stresses.

B. Attachments to New Concrete: Bolt to channel-type concrete inserts or use expansion anchors.

C. Attachments to Existing Concrete: Use expansion anchors.

D. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.

E. Attachments to Solid Concrete Masonry Unit Walls: Use expansion anchors.

F. Attachments to Hollow Walls: Bolt to slotted steel channels fastened to wall with expansion anchors.

G. Attachments to Wood Structural Members: Install bolts through members.

H. Attachments to Steel: Bolt to clamps on flanges of beams or on upper truss chords of bar joists.

3.3 ELECTRICAL EQUIPMENT ANCHORAGE

A. Anchor rigidly to a single mobile structural element or to a concrete base that is structurally tied to a single mobile structural element.

B. Anchor panelboards, cable trays as follows:
1. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Install to allow for resilient media where equipment or equipment-mounting channels are attached to wall.
2. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

3.4 SEISMIC BRACING INSTALLATION

A. Install bracing according to spacings and strengths indicated by approved analysis.

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B. Expansion and Contraction: Install to allow for thermal movement of braced components.

C. Cable Braces: Install with maximum cable slack recommended by manufacturer.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to the structure at flanges of beams, upper truss chords of bar joists, or at concrete members.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Make flexible connections in raceways, cables, wireways, cable trays, and busways where they cross expansion and seismic control joints, where adjacent sections or branches are supported by different structural elements, and where they terminate at electrical equipment anchored to a different mobile structural element from the one supporting them.

END OF SECTION 16071

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SECTION 16075 - ELECTRICAL IDENTIFICATION

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 electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

A. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.

B. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).

C. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick (152 mm wide by 0.102 mm thick).
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend indicating type of underground line.

D. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

E. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

2.2 NAMEPLATES AND SIGNS

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A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.

C. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.3 kg) minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:
1. Clean surfaces of dust, loose material, and oily films before painting.
2. Prime surfaces using type of primer specified for surface.

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3. Apply one intermediate and one finish coat of enamel.

F. Paint fire alarm junction boxes red.

G. Circuit Identification Labels on Boxes: Install labels externally for all installed boxes prior to installation of conductors.
   1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
   2. Concealed Boxes: Plasticized card-stock tags.
   3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

H. Circuit Identification Labels on Plates: Install labels externally for all installed wiring device plates indicating panel and circuit number.
   1. Clear preprinted adhesive labels.

I. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

J. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker..

K. Color-Coding of Secondary Phase Conductors: Color code switch legs, travelers and other wiring for branch circuits other than those listed below. Use the following colors for service, feeder and branch-circuit phase conductors:
   1. 208/120-V Conductors:

      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Neutral: White.
      e. Ground: Green.
      f. Insulated Ground: Green with white stripe.
   2. 480/277-V Conductors:

      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: Gray.
      e. Ground: Green.

   3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 6 AWG:

      a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent

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possible unwinding. Use 1-inch- (25-mm-) wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.

L. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.

1. Legend: 1/4-inch- (6.4-mm-) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
2. Tag Fasteners: Nylon cable ties.
3. Band Fasteners: Integral ears.

M. Apply identification to conductors as follows:

1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.

N. Apply warning, caution, and instruction signs as follows:

1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
3. Install caution signs for enclosures Over 600 V: Indicate system voltage on black, preprinted on orange field.

O. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:

1. Interior and exterior of panelboards, electrical cabinets, and enclosures.

a. Branch Panelboards: Identify distribution panel and circuit serving panelboard.
b. Main Overcurrent Protection: Identify main device and service disconnects.

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2. Disconnect switches.

    a. Identify equipment designation, fla.

3. Motor starters.

    a. Identify equipment designation, horsepower of fan, fla, and heater size.

4. Push-button stations.
5. Contactors.
6. Remote-controlled switches.
7. Dimmers.
8. Fire alarm equipment
9. Access control system equipment.

P. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
    1. Existing Panelboards: identify existing circuits as well as new circuits in new framed, typed circuit schedules.

END OF SECTION 16075

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SECTION 16080 - ELECTRICAL TESTING

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 general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:

1. Suitability of test equipment.
2. Calibration of test instruments.
3. Coordination requirements for testing and inspecting.
4. Reporting requirements for testing and inspecting.

1.3 QUALITY ASSURANCE

A. Test Equipment Suitability: Comply with NETA ATS, Section 5.2.

B. Test Equipment Calibration: Comply with NETA ATS, Section 5.3.

PART 2 - NOT USED

PART 3 - EXECUTION

3.1 GENERAL TESTS AND INSPECTIONS

A. Comply with all testing requirements of authorities having jurisdiction.

B. Test all systems to be free of mechanical and electrical defects. Comply with requirements of other Division 16 sections “Electrical”.

C. Prior to performing specified testing, prepare systems, equipment, and components for tests and inspections, and perform preliminary tests to ensure that systems, equipment, and components are ready testing. Include the following minimum preparations as appropriate:

1. Perform insulation-resistance tests.
2. Perform continuity tests.
3. Perform rotation test (for motors to be tested).
4. Provide a stable source of single-phase, 208/120-V electrical power for test instrumentation at each test location.

D. Test and Inspection Reports: In addition to requirements specified elsewhere, report the following:

1. Manufacturer's written testing and inspecting instructions.

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2. Calibration and adjustment settings of adjustable and interchangeable devices involved in tests.
3. Tabulation of expected measurement results made before measurements.
4. Tabulation of "as-found" and "as-left" measurement and observation results.

3.2 FINAL PUNCHLIST

A. Coordinate site construction observation visit to prepare final punchlist and coordinate the presence of:

1. Electrical Engineer
2. Electrical Installer project foreman
3. Fire Alarm manufacturer's representative
4. Fire Marshall or his representative
5. Other Special Systems job foreman
6. Owner's representative

B. Pre-observation Meeting

1. List incomplete items, value of incomplete work, and reasons for being incomplete.
2. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner.
3. Review O&M submittals and record documents for general completeness prior to submittal for Engineer's review.
4. DFCM Electrical Specialist

C. Prepare electrical installation to facilitate efficient testing and observation.

1. Remove covers for Panelboards.
2. Remove covers for Special System Equipment.
3. Provide clear access for all equipment.
4. Complete labeling of all equipment.
5. Energize all lighting fixtures.
6. Make arrangements for keys necessary to make observations.
7. Measure voltage and amperage at each switchboard, panelboard, motor control center, and transformer. Report abnormal conditions.

END OF SECTION 16080

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SECTION 16120 - CONDUCTORS AND CABLES

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 building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field Quality-Control Test Reports: From Contractor.

1.4 QUALITY ASSURANCE

A. Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

B. 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.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CONDUCTORS AND CABLES

A. Manufacturers:

   1. Copper Wire and Cables:

      a. Alcan Aluminum Corporation; Alcan Cable Div.
      b. American Insulated Wire Corp.; a Leviton Company.
      c. General Cable Corporation.
      d. Senator Wire & Cable Company.

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e. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper, minimum size #12 for phase conductors and #14 for control conductors complying with NEMA WC7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductor Insulation Types: Type THWN-2 complying with NEMA WC7.

E. Multiconductor Cable: Metal-clad cable (Type MC) with ground wire.

2.3 CONNECTORS AND SPLICES

A. Manufacturers:

1. AFC Cable Systems, Inc.
2. AMP Incorporated/Tyco International.
3. Burndy.
4. Hubbell/Anderson.
5. Ilsco.
6. O-Z/Gedney; EGS Electrical Group LLC.
7. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Exposed Feeders: Type THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THWN-2, single conductors in raceway.Exposed Branch Circuits, including in Crawlspaces: Type THWN-2, single conductors in raceway**.**

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THWN-2, single conductors in raceway.

F. Branch Circuits in Metal Stud Walls and Partitions: Metal-clad cable, Type MC, in steel stud walls in lengths between outlets 30’ or less and not as home runs.

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THWN-2, single conductors in raceway.

H. Underground Feeders and Branch Circuits: Type THWN-2, single conductors in raceway.

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I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.

J. Fire Alarm Circuits:
   1. Type THWN-2 in raceway for fire alarm power circuits, for horn circuits, and for strobe circuits.
   2. Power-limited, fire-protective, signaling circuit cable in raceway for initiating loop circuits.

K. Emergency circuits: Install in separate raceways from all other wiring, except where they connect to the same equipment for two-source operation.

L. Class 1 Control Circuits: Type THWN-2, in raceway.

M. Class 2 Control Circuits: Type THWN-2, in raceway**.**

N. Fixture Conductors: Install conductors in lighting fixtures with insulation ratings as recommended by the manufacturer's written instructions or a minimum 90 degrees C., whichever is higher.

O. Communication Conductors: Install communication conductors in raceway.

3.2 INSTALLATION

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Multi-wire branch circuits: install no more than three circuits in a raceway, unless specifically shown otherwise. Install #10 conductors for branch circuits for which the distance from panelboard to furthest outlet is more than 100' for 120 volt or more than 140' for 277 volt circuits.

C. GFI circuit breakers or feed-thru outlets to outlets served: provide separate neutrals.

D. Panelboards, switchboards, MCCs, switchgear: Do not route conductors through a section which terminate in another section, except for interconnecting control conductors.

E. Remove existing conductors from raceway before pulling in new wires and cables.

F. Parallel conductors: Where parallel conductors are installed in parallel raceways, install in each raceway conductors of phase, neutral and/or ground as specified. Carefully cut parallel conductors to identical length for each phase leg. Do not parallel conductors less than #1/0.

G. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

H. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

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J. Do not install wiring through any part of a transformer vault or elevator equipment room and shaft that is does not serve equipment in the respective room. Also, coordinate that piping or other items foreign to the transformer vault, elevator equipment room or shaft is not installed in these spaces.

K. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."

L. Seal around cables penetrating fire-rated elements to match the rating of the penetrated material.

M. Identify and color-code conductors and cables according to Division 16 Section " Electrical Identification."

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Conductor splices: Minimize conductor splices. Do not install in conduit bodies.

C. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors. Install compression type connectors for aluminum conductors or copper pigtail adapters for installation in mechanical lugs.

D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

E. Furniture connections: connect systems furniture to power supply circuits per manufacturer’s written instructions.

F. Panelboard connections: do not splice conductors in panelboards.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

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END OF SECTION 16120

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SECTION 16130 - RACEWAYS AND BOXES

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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
2. Division 16 Section "Seismic Controls for Electrical Work" for seismic restraints and bracing of raceways, boxes, enclosures, and cabinets.
3. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. 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.

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B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Manufacturer:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. Electri-Flex Co.
5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
6. LTV Steel Tubular Products Company.
7. Manhattan/CDT/Cole-Flex.
8. O-Z Gedney; Unit of General Signal.
9. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

E. Plastic-Coated IMC and Fittings: NEMA RN 1.

F. EMT and Fittings: ANSI C80.3.

1. Fittings: Steel set-screw or compression type. Do not use die-cast fittings.

G. FMC: Zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings: NEMA FB 1; compatible with conduit and tubing materials. Do not use die-cast fittings.

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2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturer:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe & Plastics Group.
6. Condux International.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; Division of Hubbell, Inc.
12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

C. RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

D. LFNC: UL 1660.

2.4 METAL WIREWAYS

A. Manufacturer:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Hinged type.

F. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturer:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Emerson/General Signal; Appleton Electric Company.
3. Erickson Electrical Equipment Co.
4. Hoffman.

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5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal.
7. RACO; Division of Hubbell, Inc.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet-PLM Division.
10. Spring City Electrical Manufacturing Co.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

F. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.6 EXPANSION FITTINGS:

A. Manufacturer:

   1. O-Z Gedney; Unit of General Signal.

B. Expansion Fittings: Malleable Iron, hot dipped galvanized, weatherproof suitable for raceway and applications

   1. Coordinate expansion requirements with Architect.

2.7 FACTORY FINISHES

A. Finish: provide manufacturer's standard prime-coat finish ready for field painting for:

   1. Raceways

B. Finish: provide manufacturer's standard paint applied before shipping to factory-assembled products for:

   1. Enclosures: Standard Grey in electrical rooms, White in finished areas.
   2. Cabinets: Standard Grey in electrical rooms, White in finished areas.

PART 3 - EXECUTION

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3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel or IMC.
2. Concealed: Rigid steel or IMC.
3. Underground, Single Run: RNC (except coated or wrapped rigid steel for bends greater than 22 degrees), coated or wrapped rigid steel.
4. Underground, Grouped: RNC (except coated or wrapped rigid steel for bends greater than 22 degrees), coated or wrapped rigid steel.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures: NEMA 250, Type 3R.

B. Indoors:

1. Exposed:

   a. Above 6' from finished floor: EMT, IMC, or Rigid Steel.
   b. Below 6' from finished floor, or subject to mechanical damage: IMC, or Rigid Steel.

2. Underground: refer to underground installation selections in outdoor paragraph above.
3. Concealed: EMT or Rigid Steel.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Damp or Wet Locations: Rigid steel conduit.
6. Boxes and Enclosures: NEMA 250, Type 1, except as follows:

   a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

C. Minimum Raceway Size:

1. Metallic Conduits: 3/4-inch trade size (DN 21).
2. Nonmetallic Conduits: 3/4-inch trade size (DN 21).

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Metal Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated. Engage a minimum of five full threads.
2. Intermediate Metal Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated. Engage a minimum of five full threads.
3. PVC Externally Coated or wrapped Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
4. EMT: set screw or compression for dry interior locations; compression for damp or wet locations; compression with tape for installations in concrete slabs above grade.
5. Building Expansion joints: use expansion fittings with 36" of wrapped metal raceways on either side of joint.

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E. Do not install aluminum conduits embedded in or in contact with concrete.

3.2 INSTALLATION

A. Layout of electrical boxes: Do not scale electrical drawings. Refer to mounting height detail sheet.

B. Existing boxes: Install new plaster rings or extension rings for existing boxes not flush with surface.

C. Outlet Boxes:

1. Frame construction: 4”X4”X1-1/2” with suitable plaster-ring, except:

a. 2-1/8” deep for boxes with 3 conduit entrances or for communication outlets
b. 4-11/16” boxes for boxes with 4 or more conduits.

2. Masonary or concrete construction: 1g or multiple gang by 3-1/2” deep.
3. Fixture Outlets: minimum 4” outlet box with 3/8” fixture stud supported adequately for minimum of 200 lbs.
4. Do not use gangable boxes.

D. Keep raceways at least 12 inches (300 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

E. Complete raceway installation before starting conductor installation.

F. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."

G. Install temporary closures to prevent foreign matter from entering raceways.

H. Stub-ups: Embed coupling flush with finished floor. If to remain a spare, the flush plug is to remain in the coupling.

I. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated. Make bends in parallel or banked runs from same centerline to make bends parallel.

1. Nonmetallic Conduits: Use rigid elbows for all bends 22 degrees or greater.
2. Communication Systems Raceways: comply with long sweep radius elbows minimum dimensions in Table 5.2-1 of ANSI/TIA/EIA-569A for all bends or offsets for backbone cables.

J. Raceways below grade: Install RNC or wrapped/coated Rigid Steel minimum 24” below grade, unless specifically noted otherwise. Where noted encase in concrete.

K. Conceal conduit and EMT within finished walls, ceilings, and floors, except at surface mounted panels and apparatus or unless otherwise indicated. Install surface raceways only where indicated or where directed by Architect.

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1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
2. Install surface raceways in rooms where surface mounted panels are indicated or for exposed equipment in mechanical, electrical, or communication rooms.

L. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

1. Maximum conduit size: Lesser of 1-inch trade size (DN 27) or 1/3 the concrete cover.

   a. For conduits larger than 1-inch trade size (DN 27), consult structural engineer for additional structural supports or other options.

2. Layout: Route conduits without crossovers. Space conduit at least 18" apart. Space raceways laterally to prevent voids in concrete.

   a. Where concentrations of conduit occur, support slab independent of steel deck. Coordinate with structural engineer.

3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
4. Install taped compression type fittings or fittings approved for such use.
5. Change from nonmetallic tubing to rigid steel conduit before rising above the floor.

M. Raceways Penetrating foundation walls: Install rigid conduit through the foundation wall or 3' each side.

N. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

O. Join raceways with fittings designed and approved for that purpose and make joints tight.

1. Use insulating bushings to protect conductors.

P. Tighten set screws of threadless fittings with suitable tools.

Q. Cap open ends of empty conduit to keep out debris until the project is completed.

R. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. For RMC and

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IMC, use two locknuts, one inside and one outside box and a bushing. For EMT, use insulated throats or plastic bushings (except for grounding bushings where required).

2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
3. Service Conduits or conduits installed in concentric/eccentric knock-outs or reducing washers: terminate raceway with grounding bushings.

S. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Plug empty raceways at both ends.

T. Low Voltage, Telephone, and Signal System Raceways, 2-Inch Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

U. Install seals for conduit penetrations of slabs on grade and exterior walls below grade. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

V. Roof Penetrations: Install flashings for conduit penetrations of roofs under the direct supervision of the roofing installer.

W. Install raceway sealing fittings at suitable, approved, and 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:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where conduits pass through airtight spaces or plenums to prevent air leakage.
3. Where conduits pass from hazardous areas to nonhazardous.
4. Where otherwise required by NFPA 70.

X. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

Y. Raceway Cleaning: Prevent accumulation of water, dirt or concrete in raceways. Where water or foreign matter have entered raceways, thoroughly clean or replace conduits where such accumulation cannot be removed by methods approved by this Engineer.

Z. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise

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transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

AA. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

BB. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 16130

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SECTION 16139 - CABLE TRAYS

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 aluminum cable trays and accessories.

B. Related Sections include the following:

1. Division 16 Section "Basic Electrical Materials and Methods" for cable tray supports not specified in this Section.
2. Division 16 Section "Seismic Controls for Electrical Work " for mounting and anchoring cable trays.

1.3 SUBMITTALS

A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Coordination Drawings: Floor plans and sections drawn to scale. Include scaled cable tray layout and relationships between components and adjacent structural and mechanical elements. Show the following:
1. Vertical and horizontal offsets and transitions.
2. Clearances for access above and to side of cable trays.
3. Vertical elevation of cable trays above floor or bottom of ceiling structure.
4. Coordinate with other installations to suit field conditions.

D. Product Certificates: For each type of cable tray, signed by product manufacturer.

E. Manufacturer Seismic Qualification Certification: Submit certification that cable trays, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

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a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Cable Tray Units: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field Test Reports: Written reports specified in Part 3.

G. Operation and Maintenance Data: For cable trays to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

B. 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.

C. Comply with NEMA VE 1, "Metal Cable Tray Systems," if cable tray types specified are defined in the standard.

D. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of cable trays and suspension system with other construction elements. Include transitions, offsets, and changes in elevation. Coordinate items that penetrate ceilings or are supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-Line Systems, Inc.
2. Chalfant Cable Trays.
3. GS Metals Corp.
4. Mono-Systems, Inc.
5. MPHusky.
6. P-W Industries, Inc.
7. Thomas & Betts Corporation.

2.2 MATERIALS AND FINISHES

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A. Cable Trays, Fittings, and Accessories: Aluminum, complying with Aluminum Association's alloy 6063-T6 for rails, rungs, and cable trays, and alloy 5052-H32 or alloy 6061-T6 for fabricated parts.

B. Protect steel hardware against corrosion by galvanizing according to ASTM B 633 or cadmium plating according to ASTM B 766.

C. Fabricate cable tray products with rounded edges and smooth surfaces.

D. Sizes and Configurations: Refer to the Cable Tray Schedule at the end of the Section Text for specific requirements for types, materials, sizes, and configurations.

2.3 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.4 FIRESTOPPING

A. Materials: UL listed and labeled and FM approved for fire ratings consistent with penetrated barriers.

B. Sleeves: Schedule 40, welded black steel pipe sleeves. Sizes as indicated or inside pipe area to match cross-sectional area of cable tray.

C. Sealing Pillows: Suitable for sealing cable penetration slots/openings in fire barriers.

2.5 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLE TRAY INSTALLATION

A. Remove burrs and sharp edges from cable trays.

B. Fasten cable tray supports securely to building structure as specified in Division 16 Section "Basic Electrical Materials and Methods," unless otherwise indicated.
   1. Locate and install supports according to NEMA VE 1.

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C. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independently of fittings. Do not carry weight of cable tray on equipment enclosure.

D. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed 90 feet (27 m). Space connectors and set gaps according to NEMA VE 1.

E. Make changes in direction and elevation using standard fittings.

F. Make cable tray connections using standard fittings.

G. Seal penetrations through fire and smoke barriers to match the rating of the penetrated material.

1. Modular removable pillows or bricks.

H. Workspace: Install cable trays with sufficient space (minimum 6”) to permit access for installing cables.

3.3 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing cable trays and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform the following electrical test and visual and mechanical inspections:

a. Visually inspect each cable tray joint and each ground connection for mechanical continuity.
b. Measure ground resistance of each system of cable tray from the most remote element to the point where connection is made to service disconnect enclosure grounding terminal. Record resistance in ohms.

3. Report results in writing.

3.5 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure cable tray is without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

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2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.

3.6 CABLE TRAY SCHEDULE

A. Run Designation: Type CTR-C
   1. Type: Ladder, trapeze-hung.
   2. Material and Finish: Aluminum.
   3. Width: 18 inches.
   4. Cross-Rung Spacing: 6 inches.
   5. Minimum Fitting Radius: 24 **inches.**
   6. Inside Depth: 2 inches.
   7. Cover Type: None.
   8. NEMA Load/Span Class: 12C

END OF SECTION 16139

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SECTION 16140 - WIRING DEVICES

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. Single and duplex receptacles, ground-fault circuit interrupters, and isolated-ground receptacles.
2. Single- and double-pole snap switches and dimmer switches.
3. Device wall plates.
4. Special purpose receptacles.
5. Floor service outlets, poke-through assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. PVC: Polyvinyl chloride.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

B. 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.

C. Comply with NFPA 70.

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1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

1.7 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. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiring Devices:

a. Bryant Electric, Inc./Hubbell Subsidiary.
b. Eagle Electric Manufacturing Co., Inc.
c. Hubbell Incorporated; Wiring Device-Kellems.
d. Leviton Mfg. Company Inc.
e. Pass & Seymour/Legrand; Wiring Devices Div.

2. Poke-Through Outlets:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Pass & Seymour/Legrand; Wiring Devices Div.
c. Square D/Groupe Schneider NA.
d. Thomas & Betts Corporation.
e. Wiremold Company (The).

3. Dimming Switches:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. Leviton Lighting Controls
c. Lightolier Controls
d. Lutron Electronics, Inc.

2.2 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

1. Thermoplastic face.
2. Thermoset base.
3. Back and side wired.

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4. Rating: 20 A minimum

B. Straight-Blade (30 A thru 50A) and Locking Receptacles: Heavy -Duty grade.

C. GFCI Receptacles: Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- (70-mm-) deep outlet box without an adapter.

D. Isolated-Ground Straight-Blade Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498; configure with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.

1. Devices: Listed and labeled as isolated-ground receptacles.
2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
3. Thermoplastic face.
4. Thermoset base.
5. Back and side wired.
6. Rating: 20 A minimum

2.3 SWITCHES

A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

1. Rating: Minimum 20A.
2. Thermoplastic face.
3. Thermoset base.
4. Back and side wired.

B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.

1. Control: Continuously adjustable vertical slider; with single-pole or three-way switching to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz, continuously; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch (130-mm) wire connecting leads.
3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 1 percent of full brightness.
4. Electronic Low-Voltage Lamp Dimmers: Modular, 120 V or 277 V, 60 Hz, continuously adjustable; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; DC protection; and 5-inch (130-mm) wire connecting leads. Exclusively designed product for electronic low voltage transformers.

2.4 WALL PLATES

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A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish, except screwless devices for locations where only dimmers are shown.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Wet Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.5 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Refer to attached wiring device product schedule..
2. Size: Selected to fit nominal 3-inch (75-mm) or 4-inch (100-mm) cored holes in floor and matched to floor thickness, based on assembly.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused 3-inch (75-mm) or 4-inch (100-mm) cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors; and a minimum of four, 4-pair, Category 5 voice and data communication cables.

2.6 FINISHES

A. Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.
2. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Install wall dimmers with capacity to achieve 60% of circuit loads indicated on drawings after derating for ganging according to manufacturer's written instructions.

C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

D. Install control wiring for electronic fluorescent dimmers (low voltage or line voltage) per manufacturers written instructions.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

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F. Wallplates and coverplates: install wallplates and coverplates for all outlets, including blank outlets.

G. GFI Devices: Install separate GFCI devices, except where installed under the same multi-gang plate.

H. Remove wall plates and protect devices and assemblies during painting.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

J. Install cord and plug sets for appliances, mechanical equipment, and other equipment per manufacturer’s written instructions.

3.2 IDENTIFICATION

A. Comply with Division 16 Section " Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with color-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

a. Black letters on light colored plates.
b. White on dark colored plates.

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 16140

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Standard Wiring Device Schedule

Note to Bidders: Comply with Section 16140 of the specifications. The catalog numbers listed below have been carefully prepared with the assistance of the manufacturer's representatives with the objective of assisting the bidders in determining the quality and ratings of the wiring device specified; however, the catalog numbers may not be complete or accurate. In addition, the color of the wiring device is not intended to be determined by the catalog numbers listed below, but shall be selected by the Architect as indicated in the specification. Each manufacturer prior to bidding shall compare catalog numbers shown with the description and shall notify the Architect/Engineer of any discrepancies.

NEMA	DESCRIPTION	CATALOG NUMBERS
NEMA 5-20R	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5352 Hubbell CR5352 Leviton 5352 P&S 5352
NEMA 5-20R GFCI	20A, 125V 2 pole 3 wire duplex feed thru GFCI receptacles with indicator light. Nylon or Lexan decorator faces. Back and side wired. Internal components shall comply with FS W-C-596 where applicable. Comply with UL 498 and UL 493.	Bryant GFR53FT Hubbell GF5352 Leviton 6898 P&S 2091 S
NEMA 5-20R Isolated Ground	20A, 125V 2 pole 3 wire isolated ground duplex grounding receptacles. Nylon or Lexan faces. Back and side wired. Comply with FS W-C-596 and UL 498.	Bryant 5362IG Hubbell CR5352IG Leviton 5362 - IG P&S IG6300
NEMA 5-20R Waterproof (Weatherproof in use)	20A, 125V 2 pole 3 wire duplex grounding receptacles. Nylon or Lexan Faces. Back and side wired. Comply with FS W-C-596 and UL 498. Fully gasketed weatherproof while in use enclosure.	Hubbell CR5352/5051-0
20A Single Pole	20A single pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1221 Leviton 1221 P & S 521 Bryant 4901
20A Three-way	20A three-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 1 HP 120V.	Hubbell CS1223 Leviton 1223 P & S 523 Bryant 4903
20A Four-way	20A four-way 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired.	Hubbell CS1224 Leviton 1224 P & S 524 Bryant 4904

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	Rated 1 HP 120V.	
20A Double Pole	20A double pole 125V-277V standard toggle switch labeled as complying UL standard 20 and with Federal Specification W-S-896. Provide Nylon or Lexan face, back and side wired. Rated 2 HP 240V. Double pole.	Hubbell CS1222 Leviton 1222 P & S 522 Bryant 4902
PT1	Fire rated poke-thru: duplex receptacle with spring loaded lift cover flaps and 2 cable openings for 6PR cables with provisions for four each RJ-45 Category 5 data jacks. Thru floor fitting shall fit in 3" diameter hole and shall be rated for floor penetrated. Provide carpet flange.	Hubbell PT7FSDX Walker RC700-A
PT2	Fire rated poke-thru: 8-wire furniture connection and 2 cable openings for 6PR cables. Thru floor fitting shall fit in 3" diameter hole and shall be rated for floor penetrated. Provide carpet flange.	Hubbell PT73FFSDX Walker RC700-6A
PT3	Fire rated poke-thru: Flush furniture feed service fitting and through –floor fitting (three service, 2 ea ½" and 1 ea ¾" conduit fittings). Provide liquid-tight conduit connections to furniture for voice data cables.	HubbellPT37FFSDX Walker RC700-6A-X

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SECTION 16145 - LIGHTING CONTROL DEVICES

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 lighting control devices:

1. Indoor photoelectric switches.
2. Indoor occupancy sensors.
3. Multipole contactors.

B. Related Sections include the following:
1. Division 16 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.
1. Lighting plan showing location, orientation, and coverage area of each sensor.
2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. 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.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 [INDOOR PHOTOELECTRIC SWITCHES]

A. Manufacturers:
   1. Watt Stopper (The).

B. Ceiling-Mounting Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
   1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
   2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.

2.4 INDOOR OCCUPANCY SENSORS

A. Manufacturers:

   1. Hubbell Lighting Inc.
   2. Leviton Mfg. Company Inc.
   3. Lithonia Lighting.
   4. MYTECH Corporation.
   5. Novitas, Inc.
   6. RAB Electric Manufacturing, Inc.
   7. Sensor Switch, Inc.
   8. TORK.
   9. Unenco Electronics; a Hubbell Company.
   10. Watt Stopper (The).

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

   1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

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2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box. Non-directional type units only are allowed.
   b. Relay: Externally mounted though a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.

C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Non-directional type only--directional-type sensors are not allowed. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving at least 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.5 MULTIPOLE CONTACTORS

A. Manufacturers:
1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Cutler-Hammer; Eaton Corporation.
4. GE Industrial Systems; Total Lighting Control.
5. Siemens.
6. Square D.

B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Control-Coil Voltage: Match control power source.

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2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 16 Section " Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Division 16 Section "Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 14 AWG, complying with Division 16 Section "Conductors and Cables."

D. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Division 16 Section "Voice and Data Communication Cabling."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 3/4 inch (20 mm).

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section " Electrical Identification."

B. Label time switches and contactors with a unique designation.

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3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

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

3.5 COMMISSIONING

A. Manufacturer Commissioning: obtain the services of the manufacturer of the occupancy sensors to test and adjust each sensor for the application to eliminate false operation.

B. Relocate sensors as required to eliminate false operation.

C. Replace defective or inappropriate sensors with sensors suitable for the function intended.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel as specified below:
1. Train Owner’s maintenance personnel on troubleshooting, servicing, adjusting, and preventative maintenance. Provide minimum of three hours’ training.
2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
3. Schedule training with Owner, through Architect, with at least seven days’ advance notice.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 16145

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SECTION 16269 - VARIABLE FREQUENCY CONTROLLERS

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 solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.

B. Related Sections include the following:
   1. Division 16 Section "Fuses" for fuses in fusible switches.

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFC: Variable frequency controller.

1.4 SUBMITTALS

A. Product Data: For each type of VFC, provide dimensions; mounting arrangements; location for conduit entries; shipping and operating weights; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

   1. Include broadband filter performance data for each filter.

B. Shop Drawings: For each VFC include printed copy and electronic copy in AutoCAD format.

   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current ratings of integrated unit.
      d. UL listing for series rating of overcurrent protective devices in combination controllers.

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e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFC. Provide schematic wiring diagram for each type of VFC.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around VFCs where pipe and ducts are prohibited. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that VFCs, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Test Reports: Written reports specified in Part 3.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 include the following:

1. Routine maintenance requirements for VFCs and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Harmonic distortion reports.
4. Bill of Materials with all spare parts ordering information.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

I. Customer Certifications:

1. Material Supply Bond: Submit material supply bond for VFCs covering equipment and services for the project. Include statement that completed

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installation complies with all requirements and provisions of the VFC specification.

2. Compliance documentation for power quality requirements.
3. Qualifications of technical engineering personnel responsible for support and warranty of equipment.
4. Extended warranty/services contract proposal in compliance with specification requirements.
5. Sample VFC approval form complying with DFCM requirements.
6. Sample VFC system commissioning form complying with DFCM requirements.
7. Sample VFC training approval form complying with DFCM requirements.
8. Sample VFC quality assurance program and sample factory test and certification report forms complying with DFCM requirements.
9. Include Certified As-built Drawings and AutoCAD files on floppy disks.
10. Submit warranty of manufacturers whose components comprise more than 25% of the cost of the system.

1.5 QUALITY ASSURANCE

A. anufacturer Qualifications: Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. DFCM Approved Field Harmonic Testing and Documentation Consultants:

1. Energy Management Corporation.
2. Power Quality Consultants.
3. Spectrum + Bennion.

C. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.

D. 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.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated dimensions and clearances.

F. Comply with NFPA 70.

1.6 WARRANTY

A. Warranties, General: 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. Special VFC Warranties: Written warranties, signed by manufacturer and Installer agreeing to replace components that fail in materials or workmanship within special warranty period.

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1. Special Warranty/Service Period: Two years from date of Substantial Completion.

    a. Include pricing to renew service contract in two-year increments thereafter.
    b. Include necessary repairs or loaner replacement assuring complete restoration of operation within 24 hours from the time a service call is requested. Pay a $200 per day penalty for failure to comply with acknowledged service request.
    c. Include job site visits twice yearly to inspect, clean, tune, and repair system.
    d. Include 200% performance bond on behalf of the Owner for the term of the service contract.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver VFCs in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.8 COORDINATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, motor speed, required control sequence, and duty cycle of motor and load.

1.9 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. Spare Fuses: Furnish one spare for every five installed, but not less than one set of three of each type and rating.

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2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide VFC products by one of the following:

1. MagneTek Drives and Systems.
2. Mitsubishi
3. Motor Drives International.
4. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
5. Siemens Energy and Automation; Industrial Products Division.
6. Toshiba International Corporation.

B. Manufacturers: Subject to compliance with requirements, provide filtering products by one of the following:

1. MTE.
2. General Electric Industrial Systems.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, standard or premium-efficiency induction motor, as specified in Division 15, by adjusting output voltage and frequency.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:

1. Input ac voltage with tolerance of plus or minus 10%: refer to drawings.

a. Voltage sag-ride-thru coordination: 0% voltage for one cycle, 60% voltage for 10 cycles, 90% voltage continuous.

2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Capable of driving full load, under the following conditions, without derating:

a. Ambient Temperature

1) Indoor: 0 to 40 deg C.

b. Humidity: Less than 90 percent (non-condensing).
c. Altitude: 4500 feet (1534 m).

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4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent.
6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
7. Starting Torque: 100 percent of rated torque or as indicated.
8. Speed Regulation: Plus or minus 1 percent.
9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.

E. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 2 to a minimum of 22 seconds.
4. Deceleration: 2 to a minimum of 22 seconds.
5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

F. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors.
2. Snubber networks to protect against malfunction due to system voltage transients.
3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
4. Motor Overload Relay: Adjustable electronic overload circuits with instantaneous trip, inverse time trip and current functions, and capable of NEMA 250, Class 20 performance.
5. Programmable skip frequencies to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
6. Instantaneous line-to-line and line-to-ground overcurrent trips.
7. Loss-of-phase protection.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Short circuit rating as indicated.
11. Ground fault protection.

G. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bi-directional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

H. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

I. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.

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J. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.

K. Input Line Conditioning: broadband filter with a minimum power quality performance of 12% current THD and 3% voltage THD at filter input.

L. VFC Output Filtering: Include output filter if drive output at motor termination exceeds pulse-withstand capability.

M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter (nonkeypad controlled).

O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

P. Control Signal Interface: Provide VFC with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Pneumatic Input Signal Interface: 3 to 15 psig (20 to 104 kPa).
3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

   a. 0 to 10-V dc.
   b. 0-20 or 4-20 mA.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.
   e. RS485.
   f. Keypad display for local hand operation.

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4. Output Signal Interface:

   a. A minimum of 1 analog output signal (0-10v/4-20 mA), which can be programmed to any of the following:

      1) Output frequency (Hz).
      2) Output current (load).
      3) DC-link voltage (VDC).
      4) Motor torque (percent).
      5) Motor speed (rpm).
      6) Set-point frequency (Hz).

5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

   a. Motor running.
   b. Set-point speed reached.
   c. Fault and warning indication (overtemperature or overcurrent).
   d. PID high or low speed limits reached.

Q. Communications: Provide an interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
   1. CSI

R. Manual Bypass: Arrange magnetic contactor to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

S. Isolating Switch: Non-load-break switch arranged to isolate VFC and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

T. Bypass Controller: NEMA ICS 2 full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

U. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.

2.3 ENCLOSURES

A. NEMA 250 with external operating handle and a safety interlock to prevent the door from opening when the unit is in operation. Mount all components in a single enclosure assembly. Include factory interconnecting wiring between all components. Do not exceed 90” high including concrete bases. Include removable panels to facilitate removal of components for maintenance. Include minimum of two hinges with

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removable pins and stiffeners required for rigid door. Include minimum of oil-tight industrial operator devices in face of door.

1. Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R
3. Other Wet or Damp Indoor Locations: Type 4.

B. Ventilation and Cooling: properly ventilate or cool VFCs for elevation and ambient environment.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type oil tight.

C. Control Relays: Auxiliary and adjustable time-delay relays.

D. Standard Displays:

1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. Motor voltage (volts).
5. DC-link voltage (VDC).
6. Motor torque (percent).
7. Motor speed (rpm).
8. Motor output voltage (V).

E. Historical Logging Information and Displays:

1. Running log of total power versus time.
2. Total run time.
3. Fault log, maintaining last four faults with time of operation stamp for each.

F. Control Circuit: Coordinate control voltage with control systems; control voltage obtained from integral control power transformer, unless otherwise indicated. Include a control power transformer with fuses and adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent capacity.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFCs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.

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B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Install drive output dv/dt protective device for all motor circuits to ensure that the peak inverse voltage does not exceed 1000 V based upon manufacturer's published data.

3.2 APPLICATIONS

A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.

B. Select rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFC mounting surface.

B. Install VFCs on concrete bases complying with Division 3 Section "Cast-in-Place Concrete."

C. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."

D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring according to Division 16 Section " Electrical Identification."

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices according to Division 16 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where available.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

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A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Testing: Perform the following field quality-control testing:

   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Document voltage and current waveforms for compliance with power quality standard. Include transformer derate analysis, telephone influence factor, true and displacement power factor, and voltage and current imbalance in the documentation.
   4. Run test conducted using actual motor accelerated and decelerated through the entire speed range.
   5. Control panel device tests: test switches, pilot lamps, keypad, special control devices.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFCs.

D. Test Reports: Prepare a written report to record the following:

   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

3.8 STARTUP SERVICE AND COMMISSIONING

A. Engage a factory-authorized service representative to perform startup service and commissioning:

   1. Verify input voltages comply with manufacturer’s specified tolerances.
   2. Upon installation completion including water and air balancing, measure line voltage (L-L and L-N) and full load current of each phase of each VFC.
   3. Verify motor rotation in all modes of operation.

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4. Verify operator devices, programming and monitoring functions.
5. Verify field signal control connections.
6. Measure and report system output voltages and current at 50% and 100%. Tune output voltage to motor nameplate rating at full speed. Verify full load current against nameplate data.
7. Tune and optimize VFC for application. Record configuration.
8. Document that overload settings are set according to actual nameplate information.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 CLEANING

A. Clean VFCs internally, on completion of installation, according to manufacturer's written instructions. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain VFCs.

1. Conduct a minimum of 4 hours of training (2 hours in the classroom and 2 hours in the field) in operation and maintenance.
2. Schedule training with at least 7 day’s advance notice.

END OF SECTION 16269

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SECTION 16410 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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 individually mounted enclosed switches and circuit breakers used for the following:

1. Motor and equipment disconnecting means.

B. Related Sections include the following:

1. Division 16 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.
2. Division 16 Section "Fuses" for fusible devices.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

D. MCP: Motor Circuit Protectors (Adjustable instantaneous trip circuit breakers).

1.4 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switch and circuit breaker.
1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations and layout of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Current and voltage ratings.
c. Short-circuit current rating.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

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C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

E. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:

1. Routine maintenance requirements for components.
2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with NEMA AB 1 and NEMA KS 1.

C. Comply with NFPA 70.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2000 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 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. Spares: For the following:

a. Fuses for Fused Switches: refer to Div 16 section “Fuses”.

2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fusible Switches:

a. Eaton Corp.; Cutler-Hammer Products.
b. General Electric Co.; Electrical Distribution & Control Division.
c. Siemens Energy & Automation, Inc.
d. Square D Co.

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, built-in fuse pullers arranged to facilitate fuse removal, lockable handle with two padlocks, and interlocked with cover in closed position.

2.3 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

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1. Outdoor Locations: NEMA 250, Type 3R.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard gray paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Equipment Disconnects

1. Maximum elevation: 48”.
2. Locate lockable disconnect near each motor complying with clearance requirements.
3. Multiple speed motors: provide switch in all motor leads.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section " Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

C. Fusible Switch Labels: Label each enclosure with “REPLACE WITH CURRENT LIMITING FUSES ONLY. CATALOG NUMBER: (FUSE CAT. NO.).”

3.4 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

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C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
2. Test continuity of each line- and load-side circuit.

B. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16410

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SECTION 16442 - PANELBOARDS

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 load centers and panelboards, overcurrent protective devices, and associated auxiliary equipment rated 600 V and less for the following types:

1. Lighting and appliance branch-circuit panelboards.

B. Related Sections include the following:
1. Division 16 Section "Seismic Controls for Electrical Work."

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

F. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, TVSS device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details for types other than NEMA 250, Type 1.
b. Bus configuration, current, and voltage ratings.
c. Short-circuit current rating of panelboards and overcurrent protective devices.
d. Layout of overcurrent devices in panelboard.
e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

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2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Seismic Controls for Electrical Work." Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
4. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

E. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Maintenance Data: For panelboards and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and

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other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.7 EXTRA MATERIALS

A. Keys: Six spares of each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   a. Square D Co. (To match existing panelboards at facility).

2.2 FABRICATION AND FEATURES

A. Enclosures: Flush- and surface-mounted cabinets as indicated on the drawings. NEMA PB 1, Type 1, to meet environmental conditions at installed location.

B. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

C. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.

D. Directory Card: With transparent protective cover, mounted inside metal frame, inside panelboard door.

E. Bus: Hard-drawn copper, 98 percent conductivity.

F. Main and Neutral Lugs: Mechanical type suitable for use with conductor material.

G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

H. Insulated Equipment Ground Bus: Adequate for feeder and branch-circuit equipment insulated ground conductors; insulate from box.

I. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

J. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

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2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: Front mounted with concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. [Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.]

B. Molded-Case Circuit-Breaker Features and Accessories. Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Examine areas where panelboards are planned to be installed. Coordinate with other installers so that installation complies with NEC 110-26.
1. Do not locate panelboards so that the door swing swings through the clear area.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."

C. Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.

D. Mounting: Plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Circuit Directory: Create a directory to indicate installed circuit loads showing locations (final room numbers as determined by user) and use. Obtain approval for room numbers to be used before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

1. Existing Panelboards: verify existing circuits and create new circuit directory.

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F. Install filler plates in unused spaces.

G. Provision for Future Circuits at Flush Panelboards: Stub six 1-inch (27-GRC) empty conduits from panelboard section into accessible ceiling space or space designated to be ceiling space in the future. Stub five 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section " Electrical Identification."

B. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

A. Install equipment grounding connections for panelboards with ground continuity to main electrical ground bus.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442

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SECTION 16491 - FUSES

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 cartridge fuses, rated 600 V and less, for use in switches, panelboards, switchboards, controllers, and motor-control centers; and spare fuse cabinets.

1.3 DEFINITIONS

A. J-TD: Class J, Time Delay

B. RK5-TD: Class RK5, Time Delay

1.4 SUBMITTALS

A. Product Data: Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings for each fuse type indicated.

B. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.
4. Fuse size for elevator feeders and elevator disconnect switches.

C. Maintenance Data: For tripping devices to include in maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

A. Source Limitations: Provide fuses from a single manufacturer.

B. 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.

C. Comply with NEMA FU 1.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

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A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (4.4 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.7 COORDINATION

A. Coordinate fuse ratings with HVAC and refrigeration equipment nameplate limitations of maximum fuse size.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged in original cartons or containers and identified with labels describing contents.

1. Fuses: Quantity equal to 10 percent of each fuse type and size, but not fewer than 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.; Bussmann Div.
2. Gould Shawmut.
3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION (Not Applicable)

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Refer to drawings for fuse types and sizes.

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1. Motor fuse sizes: Field select motor fuse sizes using the class of fuse shown on the drawings and sizing the fuse based upon the motor nameplate information and by multiplying by 1.25 (except for special service motors).

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16491

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SECTION 16511 - INTERIOR LIGHTING

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. Interior lighting fixtures with lamps and ballasts.
2. Lighting fixtures mounted on exterior building surfaces.
3. Emergency lighting units.
4. Exit signs.

B. Related Sections include the following:

1. Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
2. Division 16 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. BF: Ballast factor. Ratio of light output of a given lamp(s) operated by the subject ballast to the light output of the same lamp(s) when operated on an ANSI reference circuit.

B. CRI: Color rendering index.

C. CU: Coefficient of utilization.

D. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.

E. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of fixture, including dimensions and verification of indicated parameters.

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2. Emergency lighting unit battery and charger.
3. Fluorescent and high-intensity-discharge ballasts.
4. Lamps.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Wiring Diagrams: Power, signal, and control wiring.

D. Product Certificates: For each type of ballast for dimmer-controlled fixtures, signed by product manufacturer.

E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 include the following:

1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.

F. Warranties: Special warranties specified in this Section.

G. Spare Parts: include spare parts materials and quantity.

1.5 QUALITY ASSURANCE

A. 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.
1. Test products to UL standards by nationally recognized testing laboratory, where an appropriate standard exists.

B. Comply with NFPA 70.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Unit Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

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B. Special Warranty for Fluorescent Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.

1.8 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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 FIXTURES AND COMPONENTS, GENERAL

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

1. Equip recessed fixtures with six foot flexible conduit whips for connection to external j-boxes, except that junction boxes may integral for prewired framing kits for incandescent and PL fluorescent downlights.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

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F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 92 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless different thickness is scheduled.
b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

J. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for heat extraction.
1. Heat Removal Units: Air path leads through lamp cavity.

2.3 LIGHTING FIXTURES

A. Fixtures: Refer to Lighting Fixture Schedule on the drawings.

2.4 FLUORESCENT LAMP BALLASTS

A. Description: Include the following features, unless otherwise indicated:

1. Designed for type and quantity of lamps indicated at full light output, unless 1.2 BF is specified except for emergency lamps powered by in-fixture battery-packs.

a. Linear Electronic Ballasts: full light output is defined as .88 BF.
b. Compact Fluorescent Ballasts: full light output is defined as 1.0 BF.

2. Externally fused with slow-blow type rated between 2.65 and 3.0 times the line current.
3. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

B. Electronic ballasts (nondimming) for linear lamps shall include the following features, unless otherwise indicated:

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1. Comply with NEMA C82.11.
2. Ballast Type: Programmed start with two-step lamp starting to extend life of frequently started lamps; if not available from any manufacturer, provide rapid start.
3. Sound Rating: A.
4. Total harmonic distortion rating of less than 20 percent according to NEMA C82.11.
5. Transient Voltage Protection: IEEE C62.41, Category A.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: Less than 1.7.
8. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.

C. Ballasts for compact fluorescent lamps in recessed fixtures shall have the following features, unless otherwise indicated:

1. Type: Electronic .
2. Power Factor: 90 percent, minimum.
3. Flicker: Less than 5 percent.
4. Lamp Current Crest Factor: Less than 1.7.
5. Electronic Ballast Operating Frequency: 20 kHz or higher.
6. Lamp end-of-life detection and shutdown circuit.
7. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

D. Ballasts for compact lamps in nonrecessed fixtures shall include the following features, unless otherwise indicated:

1. Power Factor: 90 percent, minimum.
2. Ballast Coil Temperature: 65 deg C, maximum.
3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.

E. Ballasts for dimmer-controlled fixtures shall comply with general and fixture-related requirements above for electronic ballasts and the following features:

1. Dimming Range: 100 to 5 percent of rated lamp lumens, unless specifically indicated otherwise.
2. Ballast Input Watts: Can be reduced from 100 to 20 percent of normal as it dims.
3. Compatibility: Certified by manufacturer for use with specific dimming system indicated.

2.5 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

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C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
   1. Battery: Sealed, maintenance-free, nickel-metal hydride or Lithium type with special warranty.
   2. Charger: Fully automatic, solid-state type with sealed transfer relay.
   3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   4. Self-diagnostic circuit: fully automatic testing and diagnostic circuit to cycle battery and test battery and lamps including reporting failures.

2.6 FLUORESCENT EMERGENCY LIGHTING FIXTURES

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.
   1. Emergency Connection: Operate one fluorescent lamp continuously to 1100 lumens minimum. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
   2. Night Light Connection: Operate one fluorescent lamp continuously.
   3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
   4. Battery: Sealed, maintenance-free, with minimum seven-year nominal life.
   5. Charger: Fully automatic, solid-state, constant-current type.

2.7 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with Federal toxic characteristic leaching procedure (TCLP) test, and yield less than 0.2 mg of mercury per liter, when tested according to NEMA LL 1.

B. T8 rapid-start low-mercury lamps, CRI of 82 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

C. Compact Fluorescent Lamps: CRI 80 (minimum), color temperature 3500, average rated life of 10,000 hours at 3 hours operation per start, unless otherwise indicated.

2.8 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 16 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

2.9 FINISHES

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A. Fixtures: Manufacturers' standard, unless otherwise indicated.
   1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
   2. Metallic Finish: Corrosion resistant.

2.10 SOURCE QUALITY CONTROL

A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

B. Factory test fixtures with ballasts and lamps; certify results for electrical ratings and photometric data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls. Adjust trims for recessed fixtures to eliminate light leaks. Install lamps in each fixture.

   1. Install fixtures with the separation from combustible material as required by lighting fixture rating, per manufacturer's written instructions; in no case, install recessed fixture within ½" of combustible material.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

   1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
   2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel or at the intersection of four tiles, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
   4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Fixture Support: As follows:

   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
   3. Extruded fixtures, Continuous Rows: Use tubing or stem for wiring at power points and cable for suspension for each unit length of fixture chassis. Include cable or stem at each end.

D. Adjust aimable fixtures to provide required light intensities.

3.2 CONNECTIONS

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A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

1. Clean transparent materials. Replace chipped or broken lenses and other damaged transparent materials.
2. Restore reflective surfaces to their reflective conditions.
3. Clean light fixtures and lamps.

B. Verify normal operation of each fixture after installation.

C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

E. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 16511

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SECTION 16724 - ACCESS CONTROL AND SECURITY SYSTEMS

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 a PC based and managed access control and security system and specifies sensors, signal equipment, system controls, and displays.

1.3 DEFINITIONS

A. Hard-Wired System: Alarm, supervisory, and detection devices are directly connected, through individual dedicated conductors, to central control panels.

1.4 SYSTEM DESCRIPTION

A. The system is an edition to an existing DSX access control system currently in use at the facility. The manufacturer, programming, protocol, platform and equipment shall match the existing system and interconnect via networked master/slave connection. Proximity card readers shall also match the existing AWID readers currently in use at the facility. The system shall be a modular access control, and alarm monitoring network that allows for easy expansion or modification of inputs, outputs, and remote control stations. The system control at the central computer location shall be under a single software program control, and shall provide full integration of all components, which shall be alterable at any time, depending upon the facility requirements. Reconfiguration shall be accomplished on-line through system programming, without hardware changes.

B. The system shall support both manual responses such as panic (duress) switches, arm and disarm stations, and automatic responses to alarms entering the system. Each alarm condition shall be capable of initiating numerous events including but not limited to: Activation of remote devices, door control, remote annunciation LED-s, and card validation.

C. Access control functions shall include but not be limited to: Validation based on time of day and day of week, holiday scheduling with card validation override, and access validation based on positive verification of card.

D. Utilizing assigned passwords, it shall be possible to define the levels of system operation for each individual operator. Operator action's range from basic monitoring to full control of the system including programming.

E. The system programming shall be user friendly, and capable of being accomplished by personnel with no prior computer experience. The programming shall be MENU driven and include on-line 'Help' or 'Tutorial' information, as well as on-line data entry examples.

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The system shall provide both supervised and non-supervised alarm point monitoring. The system shall be capable of arming or disarming alarm points both manually and automatically, by time of day, and day of week.

F. The system shall interface with the fire alarm system and the event of an alarm, shall release all controlled doors and put them in Aaccess@ or as indicated.

1.5 FUNCTIONAL PERFORMANCE

A. The new access control equipment shall interface and match the protocol and programming of the existing system. Card readers shall match exactly the card readers currently in use at the facility. The system shall consist of intelligent controllers used in a distributed processing configuration. Each controller shall retain all data necessary for system operation in it's own RAM. Each controller will contain an integrated real time clock which continues to govern events even if communication with the host computer is interrupted.

B. The system host computer shall act as an interface point with the controller network, a data base management tool, and a transaction storage device. Upon the successful entry of passwords, the host computer shall be accessible via the owners computer network utilizing LAN network software and hardware.

C. Card access system basic requirements:

1. Provide a system including but not limited to the following capabilities:

a. ADD, DELETE, REPORT or EDIT cardholder information.

b. Cardholder information shall include unique card number up to 12 digits and optional Personal Identification Number

c. Provide 16 user fields, 5 searching.

d. Provide storage of all system transactions in a retrievable history file.

e. Provide ability to program descriptions for all system alarm points.

f. Provide ability to program description for all system output relays.

g. Provide ability to program description for all system card readers.

h. Video monitoring (not used).

i. Monitor both supervised and non-supervised alarm points.

j. Report alarm point activity or status.

k. The reporting shall notify system of 'Alarm,' 'Normal,' or 'Trouble' condition.

l. Display Floor-plan graphic for any alarm point. (Not used)

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m. Display Floor-plan graphic for card activity. (Not used)

n. Interlock any alarm point condition to an output relay.

o. Interlock any alarm point condition to another alarm point.

p. Program alarms and associate incoming alarms with related outputs.

q. Bypass alarms in the system.

r. Log all events by time and date.

s. Allow select of logging transactions to more than one system printer.

t. Provide capability to store all or selected system transactions in a disk file (History files).

u. Provide reporting capability for printing of selected system transactions from the disk files by time or date selection.

v. Provide complete data base reporting of all data programmed into the system data files.

w. Execute alarm interrupts in all modes of operation.

x. Provide operator password control of all system functions.

y. Provide ability to make system configuration changes at any time.

z. Provide mode of system operation that requires operator access level which defines area's of valid access and day of access.

aa. Provide special card options such as time zone reference which defines valid time including; limited uses that provide specific number of uses, visitor use which provides specific number of days.

ab. Allow 'trace' function; display all usage of a card.

ac. ADD, DELETE, REPORT or EDIT time zone definitions. Time zone definitions shall include; starting time, ending time, days of the week, holiday override and a provision to link multiple time zone definitions.

ad. ADD, DELETE, REPORT or EDIT access level definitions. The access Levels shall define specific points of access.

ae. ADD, DELETE, REPORT or EDIT action messages. The action messages may be displayed upon specific alarm activity or card usage.

af. System shall support 'global anti-passback', allow cardholder to enter / exit any card reader.

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ag. Provide the ability to create, edit, or delete unique floor-plan graphics. (Not used)

ah. Provide the ability to acknowledge any alarm.

ai. Provide mode of system operation that requires operator acknowledgment of system commands.

aj. Provide mode of operation that does not require operator acknowledgment of alarms or system commands.

ak. Provide the ability to log operator transactions on the system printer as well as in the history files.

al. Provide capability through software to initiate auto-dial modem command to establish communications with remote control panels via standard telephone circuits. (Not used)

am. Allow disabling of alarm messages.

an. Provide ability to associate an extended message for any alarm.

ao. Provide capability to place remote control panels in an off-line mode. In the off-line mode, the remote control panels shall retain a historical summary of all control panel transactions.

ap. Provide programmable 'delay' setting for all system alarm points. The system shall not report the alarm condition until the delay setting has expired.

aq. Video interface (Not used).

ar. Provide the ability in the dynamic alarm display to color code each specific alarm point action of: alarm, normal, trouble and time zone control. (Not used)

as. Provide ability for manual operator control of system output relays. The manual functions shall include the ability to energize, de-energize, or pulse the output relay. The pulse time shall be a programmable setting.

at. Support multiple card reader technology including:

1. Wiegand effect.
2. Magnetic strip.
3. Proximity.
4. Biometrics.
5. Bar Code.
6. Support use of keypad for access control.
7. Support use of card/keypad (PIN) for access control.

D. Special system functions (Not used)

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E. Time and attendance

1. Provide specific shift definitions of:

a. Normal shift time.
b. Allowable break time.
c. Over time definition.
d. Normal work week / month.
e. Provide report of 'Time-In,' 'Time-out' by cardholder, or by department or description.
f. Provide report of hours calculated.

G. Event programming by time.

H. Arm / disarm alarm points by time zone definition.

I. Activate / deactivate output relays by time zone.

J. Interface with other computer systems.

J. Provide pick lists for all system required information that the user has previously entered.

1.6 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data for system components, including "Nationally Recognized Testing Laboratory" (NRTL) listing data and list of materials, dimensioned plans, sections, and elevations showing minimum clearances, mounting arrangements, and installed features and devices.

C. Wiring diagrams for system, including all devices, components, and auxiliary equipment. System diagram is unique to the Project system; a manufacturer's generic system diagram is not acceptable. Diagrams differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.

D. System operation description, including method of operation and supervision of each component and each type of circuit, and sequence of operations for all manually and automatically initiated system inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are not acceptable.

E. Operation and maintenance data for inclusion in "Operating and Maintenance Manual" specified in Division 1. Include data for each type product, including all features and operating sequences, both automatic and manual. Include user's software data and recommendations for spare parts to be stocked at the site. Provide names, addresses, and telephone numbers of service organizations that stock repair parts for the system.

F. Product certifications signed by the manufacturers of system components certifying that their products comply with the referenced standards.

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G. Separate Qualification Data for Manufacturers and Installers: Demonstrate their capabilities and experience as specified in Quality Assurance Article. Include lists of completed projects with project names and addresses, names of Engineers and Owners, plus other information specified.

H. Record of field tests of system.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms with a minimum of 5 years experience in manufacturing equipment of the types and capacities indicated that have a record of successful in-service performance. The prime system manufacturer shall maintain a service center capable of providing training, parts, and emergency maintenance and repairs for the overall system.

B. Installer Qualifications: The installer shall be a factory authorized sales and services representative of the system submitted. At the time of bid, the bidder shall have a minimum of 5 years of experience installing systems of similar size, complexity, and general operation as the system described in this specification. When requested to do so, the installer shall furnish, in writing, proof of compliance with system manufacturers service and installation certification programs. Installer must be capable of providing emergency maintenance and repairs for the overall system at the project site with 24 hours maximum response time. The installer shall have a local office staffed with factory trained technicians, fully capable of supervising installation, system start-up, providing training and servicing of both hardware and software for systems of similar complexity and function as the system described in this specification.

C. Comply with NFPA 70, "National Electrical Code."

D. Listing and Labeling: Provide system and components that are listed and labeled for their indicated use and location on the Project.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Comply with UL Standard 609, 1023, and 1076.

F. FM Compliance: Provide FM-approved card access system and components.

G. Single-Source Responsibility: Obtain system components from a single source (the prime system manufacturer) that assumes responsibility for system components and for their compatibility.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. DSX Systems

2.2 ACCESS CONTROL SYSTEM EQUIPMENT, GENERAL

A. Surge Protection: Comply with minimum requirements of UL Standard 1449, "Transient Voltage Surge Suppressors," for each component using solid-state devices and having a line voltage power source connection or an exterior underground signal connection.

B. Provide at the locations identified, a completely operational Access Control and Securitty System including but not limited to the following equipment:

1. Proximity-Type Card Readers
2. Access control panels
3. Relay output contacts
4. Arm and disarm panels
5. All power supplies or transformers
6. All equipment, security devices, components, wire, cable, and mounting hardware as required to meet specification requirements and manufacturers documented installation procedures.

C. Basic Central System Components:

1. Central Processing Unit and door controllers to meet the system fuctional specifications listed above and for the number of readers as indicated in the drawings.

2. System Software: The access control system software shall serve as a database manager, controlling card/keycode data, access levels, timezone/holiday schedules and alarm point information and provide for a complete, fully integrated system . The software shall provide a means to download all database information to the individual control panels. The software shall be menu-driven, allowing straight-forward programming and operation. The software shall be user-oriented, with help screens, instructional prompts and English description displays. The software shall utilize pick list for all previously enter system required data. All system programming shall be performed at the computer keyboard.

a. Printer Output: The software shall support direct report printing.
b. Monitor Display: The software shall display all system activity on a color or monochrome monitor, in real time. The software shall cause an audible tone upon all alarm conditions. The software shall provide an optional manual keyboard acknowledge function for all incoming alarm messages.
c. Disk Storage: The software shall store user-selected activity on the hard disk. Report options shall recall selected history information from the hard disk. The user may request report information based on selected cardholders, specific areas and/or specific times. A unique history file shall be created each day, allowing backup of selected files to floppy disk.

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d. Databases: The software shall create independent databases for selected groups of information (cards, timezones, etc.), allowing backup of selected files to floppy disk. The software shall provide edit, add, delete, find and print options for records in selected databases.

e. English Descriptions: The software shall support descriptive names for all database entries. The card database shall include name, number, department, description and six note fields and or nine user defined fields.

f. Password Protection: The software shall provide password protection , with user-defined operator name/password combinations. Name/password log-on shall restrict operators to selected areas of the program.

g. Action Messages: The software shall allow recall of user-created text messages upon alarm condition.

h. Manual Panel Control: The software shall allow manual control of selected input and output points. Manual panel control shall include pulse and energize/de-energize options for output points and shunt/unshunt options for input points.

i. Terminal Mode: The software shall provide a terminal mode of operation, to allow direct communication from the computer to the control panels, for trouble-shooting capability.

2.3 HOST PC REQUIREMENTS

A. The system software must operate on an "off the shelf" IBM compatible PC. This PC must have Intel or equivalent mother board and an industry standard BIOS. Any PC with a proprietary BIOS, DOS, or other software is not acceptable. Provide PC-s with a minimum of the following hardware features:

2. Pentium 166 MHz or better
3. 32M of Memory
4. 1.44M 3.5" Floppy Drive
5. 6X compact disc drive
6. 2.1 gigabyte hard drive
7. 14" VGA Color Monitor
8. Microsoft mouse.
9. Minimum of one Serial Data Communication Ports
10. Minimum of one Parallel Printer Port
10. Windows 95 operating system software
11. Autodial/autoanswer modem
12. Y2K Compatible

2.4 ELECTRICAL POWER

A. Normal System Power Supply: 120 V 60 Hz from locked disconnect device. System components are supplied with power through the system control panel.

B. Power Source Transfer: When normal power is interrupted, system is automatically switched to backup supply without degradation of critical system function or loss of signals or status data.

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1. Backup Source: Batteries in power supplies of individual system components. Such batteries are an integral part of power supplies of the components.
2. Annunciation: Switching of the system or any system component to backup power is indicated as a change in system condition.

2.5 CARD ACCESS SYSTEM HARDWARE, GENERAL

A. Types, features, accessories, and mounting conditions of individual devices are as indicated.

B. Input Points: An access control panel supporting proximity-type card readers shall provide a minimum of 8 input points.

C.. Output Points: The access control panel shall provide a minimum of two double-pole, double-throw (DPDT) form C relays, rated for 12 VDC at 3 amps. Provide additional output points if necessary as indicated for this project.

D. Battery Back-up: The access control panel shall provide an 8 VDC back-up battery for up to 60 hour operation upon loss of AC power. The access control panel shall provide a 3 VDC lithium battery to retain database information for up to 30 days upon loss of power.

E. Suppression: The access control panel shall have provisions for relay suppressor kits for each relay used, to protect the access control panel from collapsing electrical fields.

F. Card Readers/Keypads: The access control panel shall support card readers using Magstripe, Barcode, Wiegand, Proximity and Biometrics technologies. The access control panel shall support a 12-button numeric keypad. Card readers with a keypad will be provided in two locations as noted, with the remaining locations being provided with card readers only.

1. Proximity Readers: AWID card readers to match the proximity readers currently in use at the facility. The system shall be provided with uni-directional proximity card readers. The card reader shall have the maximum read range available in the industry. The reader shall be able to be mounted with its sides against metal door or window frames, and masonry walls. The reader shall be powered by an external +12VDC regulated power supply. The card shall use 32 or 34 bits and have a label indicating the encoded number. The reader shall meet the following specifications:

   a. Electrical: Voltage +12 VDC nominal voltage (10.5-14 volts), 130 mA.
   b. Environmental: Outdoor operating temperature -30 to +65 degrees. Indoor operating temperature 0 to +50 degrees.

G. Cards: The access control system shall be provided with 150 proximity cards. Proximity cards shall be provided with factory embedded identification number. The cards shall incorporate radio frequency identification electronics into a predominantly polycarbonate package. Cards shall be a maximum of .070 inches thick and weigh a maximum of .24 ounces. The cards shall be capable of operating in temperatures from -50 degrees to 160 degrees F, and in relative humidity from 5% to 95%.

2.6 CARD ACCESS SYSTEM FIRMWARE, GENERAL

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A. Card/Keycode Capacity: The access control panel shall store a minimum of 3000 cards/key codes, expandable to a minimum of 9000 with memory upgrade.

B. Buffer Capability: The access control panel shall support an optional buffered mode of operation. When operating in the buffered mode, the access control panel shall store all transactions in memory, rather than transmitting them through the communication loop. The access control panel shall transmit the buffered (stored) information upon request. The access control panel shall buffer a minimum of 1850 transactions, expandable to 5000 with a memory upgrade.

C. Format Commands: The access control panel shall store a minimum of five format (software) commands, allowing use of cards with various bit structures and encoding schemes.

D. Site Codes: The access control panel shall store up to three site codes for card use.

E. Limited Use/Visitor Status Cards: The access control panel shall support the use of Limited Use and Visitor status cards. Limited Use cards shall be valid from 1-254 times, after which they will expire. Visitor cards shall be valid from 1-254 days, after which they will expire.

F. Cards (digits): The access control panel shall be capable of recognizing card numbers up to 12 digits as an option.

G. Anti-Passback: The access control panel shall support the use of an anti-passback mode, in which cardholders are required to follow a proper in/out sequence.

H. Global Anti-Passback: The access control panel in the system shall support the use of an anti-passback mode, in which cardholders are required to follow a proper in/out sequence on a per loop basis for system anti-passback.

I. Personal Identification Numbers (PINs): The access control panel shall support the use of card readers in conjunction with keypads, in which users are required to enter a PIN, followed by a card, to gain access.

J. Time Zones: The access control panel shall store up to 63 timezones.

   a. Each timezone shall include a start time, end time, day of week specification and holiday specification.
   b. Timezones may be assigned to cards to define when the cards allow access.
   c. Timezones may be assigned to input points, to define when the input points are shunted (de-activated).
   d. Timezones may be assigned to output points (relays), to define when the output points are energized, for timed control of doors or devices.

K. Input Points: The user shall have the ability to assign shunt times to input points, from 1-60 seconds, minutes, and hours.

L. Output Points: The user shall have the ability to assign pulse times to output points, from 1-60 seconds, minutes, and hours.

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M. Interlocking: The user shall have the ability to interlock selected input and output points, in any combination. An interlocked input or output point shall take action based upon a change of state from another input or output point.

N. Group Control: The access control panel shall store a minimum of 32 relay group definitions. Each group may be controlled with the same options available for individual relays.

O. Holidays: The access control panel shall recognize up to 32 days as holidays, for override of normal system operation.

P. Enclosure: The control panel enclosure shall have hinge cover with key lock. A control panel input point shall monitor an enclosure tamper switch.

2.7 DOOR CONTACT INDICATORS

A. Electromagnetic door locks with the door contact indicators integral to the device will b e furnished and installed by others..

B. Contact indicators on doors without electromagnetic door locks shall be magnetic reed switch type, and shall be per manufacturers recommendations for the type of door installed on. Use concealed types.

2.8 REQUEST TO EXIT DEVICES

A. Comply with UL Standard 639, and the following general requirements:

1. Passive Infrared (PIR) Devices: Detect request to exit by monitoring infrared energy emitted within the door exit zone. Units are sensitive to the infrared wavelengths emitted by the human body and are insensitive to general area thermal variations.

2. Pushbutton: Double pole, double throw momentary switch mounted on a stainless steel plate.

2.9 REQUEST TO OPEN DEVICE:

A. Pushbutton: Double pole, double throw momentary switch mounted on a stainless steel plate.

2.10 SYSTEM PRINTER

A. Description: Dot-matrix type. Provide as an integral part of the card access system.

2.11 DIALER/COMMUNICATOR

A. Provide a dialer or communicator compatible with the access control system to allow off site notification over telephone lines. It shall be capable of two number dialing.

2.12 POWER SUPPLIES.

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A. Provide access control power supplies as per manufacturers written recommendations with total number of powered devices for each power supply restricted to only consuming 75 percent of the power supplies rated amperage . Provide separate power supplies for access controllers and for access locking devices.

2.13 WIRE AND CABLE

A. General: Stranded copper. Size conductors as required by system manufacturer.

B. Comply with Division 16 Section "Wires and Cables" except as indicated.

C. Cable for Low-Voltage Control and Signal Circuits: Unshielded, twisted-pair cable, except where manufacturer recommends shielded cable. Comply with Division 16 Section "Control/Signal Transmission Media."

2.14 RACEWAY

A. Comply with Division 16 Section "Raceways."

2.15 MISCELLANEOUS HARDWARE

A. General: System includes supports, mounting brackets, and installation hardware for components. Metal hardware is of corrosion-resistant material.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install system according to NFPA 70, applicable codes, and manufacturer's printed instructions.

B. Wiring Method: Install wiring in raceways. Conceal raceways except in unfinished indoor spaces. Conduit fill shall not exceed 40%.

C. Wiring Within Panels And Enclosures: Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars and distribution spools.

D. Number of Conductors: As recommended by system manufacturer for functions indicated.

E. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.

F. Tighten connections to comply with tightening torques specified in UL Standard 486A.

G. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so media are identified and coordinated with system wiring diagrams.

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H. Install power supplies and other auxiliary components for detection devices at the access control panel or at a data-gathering panel except as otherwise indicated. Do not install such items in the vicinity of the devices they serve.

3.2 GROUNDING

A. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and system pretesting, testing, adjustment, and programming.

B. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

C. Pretesting: Align and adjust the system and perform pretesting of all components, wiring, and functions to verify conformance with specified requirements. Correct deficiencies by replacing malfunctioning or damaged items with new items. Retest until satisfactory performance and conditions are achieved.

D. Testing: Provide at least 10 days' notice of acceptance test performance schedule.

E. Operational Tests: Perform operational system tests to verify conformance with specifications. Test all modes of system operation and intrusion detection. Methodically test for false alarms in each zone of space intrusion detection devices by simulating activities outside indicated detection patterns.

F. Retesting: Correct deficiencies and retest until the total system meets the requirements of the Specifications and complies with applicable standards.

G. Test and Inspection Reports: Prepare test and inspection reports, submit to project engineer prior to acceptance test.

H. Installer Start-up Responsibility: The Installer shall initiate system operation. Competent start-up personnel shall be provided by the Installer on each consecutive working day until the system is fully functional. Upon reoccurring technical problems, the Installer shall supply factory direct Manufacturer's support in the form of factory technical representation and/or diagnostic equipment until the resolution of those defined problems.

3.4 ADJUSTMENT

A. Occupancy Adjustments: When requested within 1 year of date of substantial completion, provide on-site assistance in adjusting and reprogramming to suit actual occupied conditions. Provide up to 3 visits to the site for this purpose without additional cost.

3.5 DEMONSTRATION

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A. Train Owner's operating personnel in the programming and operation of the system. Train Owner's maintenance personnel in the procedures and schedules involved in preventive maintenance and in programming, operating, adjusting, troubleshooting, and servicing of the system. Provide a minimum of 4 hours training.

B. Schedule training with advance notice of at least 7 days.

END OF SECTION 16724

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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 fire alarm systems with manual stations, detectors, signal equipment, controls, and devices.

1.3 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

A. General: Noncoded, addressable-analog system with manual and automatic alarm initiation; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Wiring Diagrams: Detail wiring and differentiate between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified.
2. Battery: Sizing calculations.
3. Floor Plans: Indicate final outlet locations and routings of raceway connections.
4. Device Address List: Coordinate with final system programming.
5. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.

C. Operating Instructions: For mounting at the FACP.

D. Product Certificates: Signed by manufacturers of system components certifying that products furnished comply with requirements.

E. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.

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F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Comply with NFPA 72.

G. Maintenance Data: For fire alarm systems to include in maintenance manuals specified in Division 1. Comply with NFPA 72.

H. Submissions to Authorities Having Jurisdiction: In addition to distribution requirements for Submittals specified in Division 1 Section "Submittals," make an identical submission to authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

I. Certificate of Completion: Comply with NFPA 72.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the FACP manufacturer for both installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Source Limitations: Obtain fire alarm system components through one source from a single manufacturer.

D. Compliance with Local Requirements: Comply with applicable building code, local ordinances and regulations, and requirements of authorities having jurisdiction.

E. Comply with NFPA 72.

1.7 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. Indicating Device—Horn/strobes: 10 spares.
2. Indicating Device – Strobe Unit: Provide 10 spares.
3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than one unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than one unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Notifier AFP-200. (Addition to existing system in facility)

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Control of System: By the FACP.

B. System Supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

C. Priority of Signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.

D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.

E. System Reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.

F. Transmission to Remote Alarm Receiving Station: Automatically route alarm, supervisory, and trouble signals to a remote alarm station by means of a proprietary network system over telephone lines.

G. Loss of primary power at the FACP initiates a trouble signal at the FACP and the annunciator. An emergency power light is illuminated at both locations when the system is operating on the secondary power supply.

H. Basic Alarm Performance Requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a flame or heat detector, operation of a sprinkler flow device, or verified automatic alarm operation of a smoke detector initiates the following:

   1. Notification-appliance operation.
   2. Identification at the FACP and the remote annunciator of the zone originating the alarm.
   3. Identification at the FACP and the remote annunciator of the device originating the alarm.
   4. Transmission of an alarm signal to the remote alarm receiving station.
   5. Unlocking of electric door locks in designated egress paths.
   6. Release of fire and smoke doors held open by magnetic door holders.
   7. Recall of elevators.
   8. Shutdown of fans and other air-handling equipment serving zone where alarm was initiated.
   9. Closing of smoke dampers in air ducts of system serving zone where alarm was initiated.

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10. Recording of the event in the system memory.
11. Recording of the event by the system printer.

I. Alarm Silencing, System Reset and Indication: Controlled by switches in the FACP.

J. Alarm Silencing, System Reset and Indication: Controlled by switches in the FACP and the remote annunciator.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

K. Water-flow alarm switch operation initiates the following:

1. Notification-appliance operation.
2. Flashing of the device location-indicating light for the device that has operated.

L. Operating a heat detector in the elevator shaft shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.

M. Water-flow alarm for connection to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.

1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.

N. Smoke detection for zones or detectors with alarm verification initiates the following:

1. Audible and visible indication of an "alarm verification" signal at the FACP.
2. Activation of a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Recording of the event by the system printer.
4. General alarm if the alarm is verified.
5. Cancellation of the FACP indication and system reset if the alarm is not verified.

O. Sprinkler valve-tamper switch operation initiates the following:

1. A supervisory, audible, and visible "valve-tamper" signal indication at the FACP and the annunciator.
2. Flashing of the device location-indicating light for the device that has operated.
3. Recording of the event by the system printer.
4. Transmission of supervisory signal to remote alarm receiving station.

P. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, scheduled, automated changes in

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sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory and are printed out by the system printer.

Q. Removal of an alarm-initiating device or a notification appliance initiates the following:

1. A "trouble" signal indication at the FACP and the annunciator for the device or zone involved.
2. Recording of the event by the system printer.
3. Transmission of trouble signal to remote alarm receiving station.

R. Printout of Events: On receipt of the signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printout of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

S. FACP Alphanumeric Display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

2.3 MANUAL PULL STATIONS

A. Description: Fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.

1. Double-action mechanism requires two actions, such as a push and a pull, to initiate an alarm.
2. Station Reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.
5. Integral Addressable Module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.

2.4 SMOKE DETECTORS

A. General: Include the following features:

1. Operating Voltage: 24-V dc, nominal.
2. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
3. Plug-in Arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base

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with a twist-locking plug connection. Terminals in the fixed base accept building wiring.

4. Integral Visual-Indicating Light: LED type. Indicates detector has operated.
5. Sensitivity: Can be tested and adjusted in-place after installation.
6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
7. Remote Controllability: Unless otherwise indicated, detectors are analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

B. Photoelectric Smoke Detectors: Include the following features:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

C. Ionization Detector: Include the following features:

1. Responsive to both visible and invisible products of combustion.
2. Self-compensating for changes in environmental conditions.

D. Beam-Type Smoke Detector: Each detector consists of a separate transmitter and receiver with the following features:

1. Adjustable Sensitivity: More than a six-level range, minimum.
2. Linear Range of Coverage: 600 feet (180 m), minimum.
3. Tamper Switch: Initiates trouble signal at the central FACP when either transmitter or receiver is disturbed.
4. Separate Color-Coded LEDs: Indicate normal, alarm, and trouble status. Any detector trouble, including power loss, is reported to the central FACP as a composite "trouble" signal.

E. Duct Smoke Detector: Ionization type.

1. Sampling Tube: Design and dimensions as recommended by the manufacturer for the specific duct size, air velocity, and installation conditions where applied.
2. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.5 OTHER DETECTORS

A. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate of rise of temperature that exceeds 15 deg F (8.3 deg C) per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

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1. Mounting: Plug-in base, interchangeable with smoke detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 NOTIFICATION APPLIANCES

A. Description: Equip for mounting as indicated and have screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Horns: Electronic-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns produce a sound-pressure level of 90 dB, measured 10 feet (3 m) from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output: As required to meeting NFPA requirements.
2. Synchronization option.
3. Strobe Leads: Factory connected to screw terminals.

2.7 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.8 CENTRAL FACP

A. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.

1. Identify each enclosure with an engraved, red, laminated, phenolic-resin nameplate with lettering not less than 1 inch (25 mm) high. Identify individual components and modules within cabinets with permanent labels.
2. Mounting: Flush.

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3. Mounting: Surface.

B. Alarm and Supervisory Systems: Separate and independent in the FACP. Alarm-initiating zone boards consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.

C. Control Modules: Include types and capacities required to perform all functions of fire alarm systems.

D. Indications: Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.

E. Indicating Lights and System Controls: Individual LED devices identify zones transmitting signals. Zone lights distinguish between alarm and trouble signals, and indicate the type of device originating the signal. Manual switches and push-to-test buttons do not require a key to operate. Controls include the following:

1. Alarm acknowledge switch.
2. Alarm silence switch.
3. System reset switch.
4. LED test switch.

F. Resetting Controls: Prevent the resetting of alarm, supervisory, or trouble signals while the alarm or trouble condition still exists.

G. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components, including annunciation, supervision, and control.

1. Display: A minimum of 80 characters; alarm, supervisory, and component status messages; and indicate control commands to be entered into the system for control of smoke detector sensitivity and other parameters.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

H. Instructions: Printed or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.9 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, reset, and test.

1. Mounting: Flush cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Individual LED for each type of alarm and supervisory device, and LEDs to indicate "normal power" and "trouble."

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1. An alarm or supervisory signal causes the illumination of a zone light, floor light, and device light.
2. System trouble causes the illumination of all lights above and also the trouble light.
3. Additional LEDs indicate normal and emergency power modes for the system.
4. A test switch tests LEDs mounted on the panel. Switch does not require key operation.

C. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.10 EMERGENCY POWER SUPPLY

A. General: Components include valve-regulated, recombinant lead acid battery; charger; and an automatic transfer switch.

1. Battery Nominal Life Expectancy: 10 years, minimum.

B. Battery Capacity:

1. Comply with NFPA 72.
2. Magnetic door holders are not served by emergency power. Magnetic door holders are released when normal power fails.
3. Minimum Capacity: 24 hour operation of complete system (except where specifically noted otherwise) plus 15 minutes with all indicating devices. In addition, include 25% spare capacity.

C. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.

D. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.11 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a multiplex system address for listed fire and sprinkler alarm-initiating devices with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall or to a circuit-breaker shunt trip for power shutdown.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled under UL 864 and NFPA 72.

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B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP panel, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising two lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 SYSTEM PRINTER

A. Description: Listed and labeled as an integral part of the fire alarm system.

2.14 GUARDS FOR PHYSICAL PROTECTION

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by the manufacturer of the device.
2. Finish: Paint of color to match the protected device.

2.15 WIRE

A. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.

B. Power-Limited Circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Connect the FACP to a circuit breaker with lockable handle.

B. Manual Pull Stations: Mount semiflush in recessed back boxes.

C. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.

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D. Ceiling-Mounted Smoke Detectors: Not less than 4 inches (100 mm) from a side wall to the near edge. For exposed solid-joist construction, mount detectors on the bottom of joists. On smooth ceilings, install not more than 30 feet (9 m) apart in any direction.

E. Wall-Mounted Smoke Detectors: At least 4 inches (100 mm), but not more than 12 inches (300 mm), below the ceiling.

F. Smoke Detectors near Air Registers: Install no closer than 60 inches (1520 mm).

G. Duct Smoke Detectors: Comply with manufacturer's written instructions.

1. Verify that each unit is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
2. Install sampling tubes so they extend the full width of the duct.

H. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

1. Synchronization: synchronize any two strobes located such that they are visible from the same location.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

M. Annunciator: Install with the top of the panel not more than 72 inches (1830 mm) above the finished floor.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Division 16 Section "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated.

B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

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C. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

E. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.

F. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

1. Paint all fire alarm system junction boxes, device boxes and pull boxes with red paint.

B. Install instructions frame in a location visible from the FACP.

C. Prepare laminated drawings showing each device and identifying the device address or zone

3.4 GROUNDING

A. Ground cable shields and equipment according to system manufacturer's written instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements in Division 16 Section "Grounding."

D. Ground equipment and conductor and cable shields. For audio circuits, minimize, to the greatest extent possible, ground loops, common-mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.5 FIELD QUALITY CONTROL

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A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and connections and to supervise pretesting, testing, and adjustment of the system. Report results in writing.

B. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the compliance of the system with requirements of Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

C. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of witnesses to preliminary tests.

D. Final Test Notice: Provide a minimum of 10 days' notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to procedures outlined in NFPA 72. Minimum required tests are as follows:

1. Verify the absence of unwanted voltages between circuit conductors and ground.
2. Test all conductors for short circuits using an insulation-testing device.
3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawings.
4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
5. Test initiating and indicating circuits for proper signal transmission under open circuit and ground fault conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
6. Test each initiating and indicating device for alarm operation and proper response at the control unit.

    a. Test smoke detectors with actual products of combustion.
    b. Test each heat detector with hair dryer or other means approved by the manufacturer.
    c. Test fan shut down, sprinkler flow and tamper switches, door closers, magnetic door holders, and elevator return.

7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.
8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

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a. Disconnect fire alarm from primary power source 24 hours prior to test, or longer as specified. Test all indicating devices to determine whether audio and visual devices comply with testing requirements for a 15 minute test.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log on the satisfactory completion of tests.

H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.6 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, adjusting, and maintaining equipment and schedules. Provide a minimum of 8 hours' training.
2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.8 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to three requested visits to Project site for this purpose.

END OF SECTION 16860

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STRUCTURAL SCHEDULES

CONCRETE FOOTING AND WALL SCHEDULES

				CROSSWISE REINFORCING				LENGTHWISE REINFORCING				
MARK	WIDTH	LENGTH	THICKNESS	NO.	SIZE	LENGTH	SPACE	NO.	SIZE	LENGTH	SPACE	COMMENTS
FC2.0	2'-0"	CONT.	12"	NONE REQUIRED				3	#4	CONT.	EQ.	
FS3.0	3'-0"	3'-0"	12"	4	#4	2'-6"	EQ.	4	#4	2'-6"	EQ.	
FS7.5	7'-6"	7'-6"	24"	8	#6	7'-0"	EQ.	8	#6	7'-0"	EQ.	TOP & BOTTOM

1. PLACE ALL FOOTING REINFORCING IN BOTTOM OF FOOTING WITH 3" CLEAR CONCRETE COVER UNLESS NOTED OTHERWISE.
2. TOP REINFORCING, WHERE SPECIFIED, SHALL BE PLACE IN THE TOP OF THE FOOTING WITH 2" CLEAR CONCRETE COVER.
3. THE SCHEDULED FOOTINGS ARE NOT NECESSARILY ALL USED.
4. FC-CONTINUOUS FOOTING.
   FS-SQUARE FOOTING.

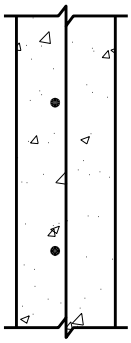
1

02026 S30

CONCRETE FOOTING SCHEDULE

NO SCALE

MARK	THICKNESS	f'c psi	REINFORCING			TYPE	COMMENTS
			VERTICAL	HORIZONTAL	TOP AND BOTTOM		
CW-1	8"	3000	#4 AT 16"oc.	#4 AT 12"oc.	(2) #5 x CONT.	A	



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2

CONCRETE WALL SCHEDULE

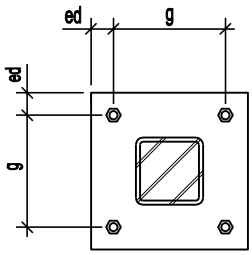
NO SCALE

02026 S30

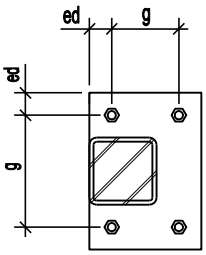
STEEL COLUMN AND BEAM CONNECTION SCHEDULES

MARK	COLUMN SIZE	STEEL BASE PLATE	STEEL CAP PLATE	COMMENTS
SC-1	TS4x4x3/8"	3/4" SBP-1	1/4" CLOSURE PLATE	
SC-2	TS4x4x3/8"	3/4" SBP-2	1/4" CLOSURE PLATE	
SC-2	TS12x8x1/2"	1" SBP-3	1/4" CLOSURE PLATE	

1. SEE "GENERAL STRUCTURAL NOTES" (GSN) FOR GRADES AND OTHER SPECIFICATIONS.
2. ALL ANCHOR BOLTS SHALL BE 3/4" DIA. x 12" HEADED BOLTS WITH A MINIMUM OF A 9" EMBEDMENT & 3" PROJECTION. ANY HOLES LARGER THAN 5/16" SHALL HAVE 5/16" PLATE WASHER INSTALLED BETWEEN THE MEMBER AND THE HARDENED WASHERS. DO NOT WELD ANY ANCHOR BOLTS. THIS INCLUDES TACK WELDING. THE ANCHOR BOLTS SPECIFIED IN THIS NOTE ARE TYPICAL UNLESS NOTED OTHERWISE.
3. ALL CAP PLATE BOLTS ARE TO BE 3/4" DIA. A-325N BOLTS UNLESS NOTED OTHERWISE.



SBP-1



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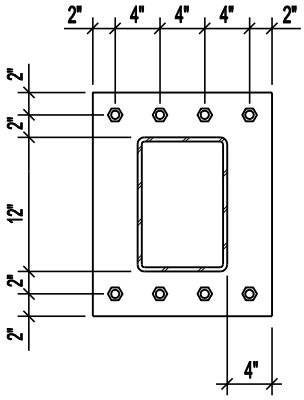


SBP-3

BASE PLATE DIMENSIONS		
g	=	BEAM GAUGE OR 3" MIN.
ed	=	EDGE DISTANCE 1 1/2" MIN.
b	=	1/2" MIN.
eq	=	EQUALLY SPACED.

7

STEEL COLUMN SCHEDULE

NO SCALE

HOUSE-041

MASONRY WALL AND LINTEL SCHEDULES

MARK	THICKNESS	HEIGHT	MATERIALS	SOLID GROUT	REINFORCING			SPECAL INSPECTION REQUIRED	COMMENTS
					VERTICAL	HORIZONTAL	JOINTS		
MW-1	8"	FULL HEIGHT	C.M.U.	NO	#5 AT 24"oc.	#5 AT 48"oc.	YES	YES	

NOTES:

1. MASONRY WALLS NOT DESIGNATED ON THE PLANS SHALL BE REINFORCED AS FOLLOWS:

THICKNESS	VERTICAL REINFORCING	HORIZONTAL REINFORCING
8"	#5 BARS AT 32"oc.	#5 BARS AT 48"oc.

2. COORDINATE WITH ARCHITECTURAL DRAWINGS, MASONRY WALL FINISHES, TYPES OF MATERIAL, COURSING, ETC.
3. DO NOT SOLID GROUT WALLS UNLESS NOTED OTHERWISE.
4. ALL MASONRY BELOW GRADE SHALL BE GROUTED SOLID.
5. VERTICAL REINFORCING SHALL BE CENTERED IN THE WALL UNLESS NOTED OTHERWISE.
6. (2) VERTICAL BARS MINIMUM AT ALL CORNERS AND END OF WALLS.
7. HORIZONTAL WALL REINFORCING SHALL BE PLACED BETWEEN VERTICAL MASONRY COLUMN REINFORCING BARS.
8. HORIZONTAL WALL REINFORCING SHALL CONTINUE THRU MASONRY LINTELS. WHERE BOTH HORIZONTAL WALL REINFORCING AND LINTEL REINFORCING OCCUR IN THE SAME COURSE, USE THE LARGER REINFORCING.
9. SEE GENERAL STRUCTURAL NOTES FOR ALL OTHER REQUIREMENTS.
10. COORDINATE ALL MASONRY LAP SPLICES WITH THE MASONRY REINFORCING LAP SCHEDULE.
11. E.F. INDICATES EACH FACE.

3

02026 S30

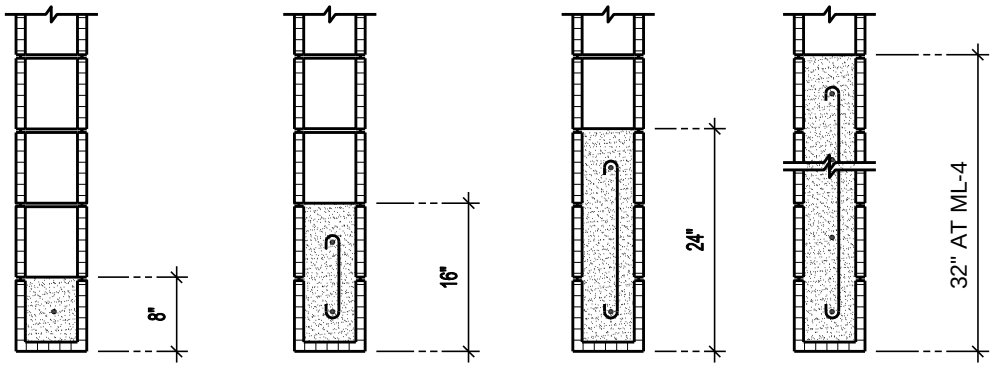
MASONRY WALL SCHEDULE

NO SCALE

LINTEL MARK	LINTEL DEPTH	LINTEL SPAN MAXIMUM	REINFORCING		COMMENTS
			HORIZONTAL	STIRRUPS	
ML-1	8"	3'-4"	(1) #7 BAR	NONE	
ML-2	16"	6'-0"	(1) #7 BAR CONT TOP & BOTTOM	#4 @ 8" O.C.	
ML-3	24"	8'-0"	(1) #7 BAR CONT TOP & BOTTOM	#4 @ 8" O.C.	
ML-4	32"	10'-0"	(2) #7 BAR CONT TOP & BOTTOM	#4 @ 8" O.C.	

MASONRY LINTEL NOTES:

1. LINTEL WIDTH AND MATERIAL TYPE SHALL BE THE SAME AS THE WALL IN WHICH THE LINTEL IS CONSTRUCTED.
2. GROUT MASONRY LINTELS MONOLITHICALLY WITH THE SUPPORT WALL OR COLUMN AT EACH END.
3. MASONRY LINTELS ML-1 THRU ML-4 SHALL BE USED OVER OPENINGS IN MASONRY WALLS WHEN A SPECIFIC MASONRY LINTEL IS NOT OTHERWISE SPECIFIED. WHEN A LINTEL IS SPECIFIED ON THE PLANS, THE MAXIMUM SPAN AS NOTED IN THIS SCHEDULE SHALL NOT APPLY. CONSULT THE STRUCTURAL ENGINEER FOR LINTELS NOT SPECIFIED ON THE PLANS WHICH HAVE A SPAN GREATER THAN 10'-0".
4. MASONRY LINTELS ML-1 THRU ML-4 SHALL NOT BE LOCATED DIRECTLY BELOW FLOOR OR ROOF BEAMS OR GIRDERS UNLESS NOTED OTHERWISE ON THE PLANS. JOISTS SHALL NOT BEAR ON ANY LINTEL LESS THAN 16" DEEP. CONSULT THE STRUCTURAL ENGINEER FOR LINTELS NOT SHOWN ON THE PLANS WHICH ARE LOCATED DIRECTLY BELOW FLOOR OR ROOF BEAMS OR GIRDERS.
5. EXTEND ALL HORIZONTAL REINFORCING 48 BAR DIAMETERS MINIMUM BEYOND THE EDGE OF ALL OPENINGS. IF HORIZONTAL REINFORCING CANNOT EXTEND 48 BAR DIAMETERS BEYOND EDGE OF OPENING, PROVIDE 90° STANDARD HOOK.
6. SPLICE TOP BARS AT MIDSPAN OF LINTEL ONLY AND BOTTOM BARS OVER SUPPORTS ONLY.
7. HORIZONTAL WALL REINFORCING SHALL CONTINUE THRU MASONRY LINTELS. WHERE BOTH HORIZONTAL WALL REINFORCING AND LINTEL REINFORCING OCCUR IN THE SAME COURSE, USE THE LARGER REINFORCING.
8. DOWEL VERTICAL REINFORCING OF WALL ABOVE LINTEL INTO THE FULL DEPTH OF LINTEL OR 48 BAR DIAMETERS, WHICHEVER IS LESS.
9. SEE GENERAL STRUCTURAL NOTES FOR ALL OTHER REQUIREMENTS.



ML-1 ML-2 ML-3 ML-4

6 MASONRY LINTEL SCHEDULE

NO SCALE

MAS-LNTL-01

MASONRY REINFORCING LAP SCHEDULE

MASONRY REINFORCING LAP SCHEDULE		
BAR SIZE	(1) BAR PER CELL	(2) BARS PER CELL
#4	24"	24"
#5	28"	28"
#6	48"	80"
#7	68"	120"
-	-	-

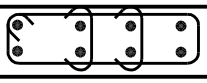
4

Concrete

MASONRY REINFORCING LAP SCHEDULE

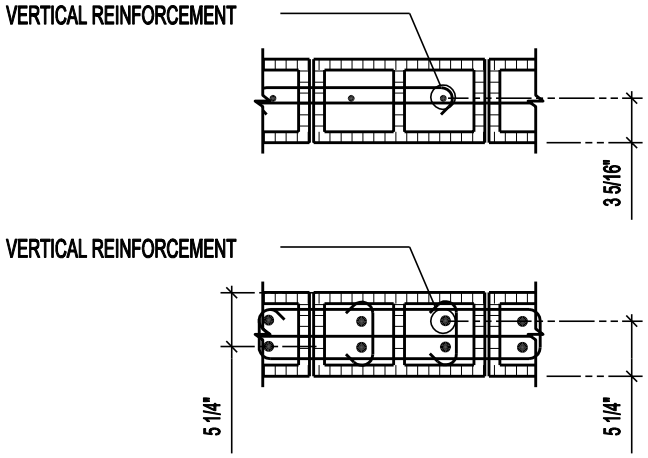
NO SCALE

MASONRY COLUMN SCHEDULE

COLUMN MARK	COLUMN SIZE	REINFORCING		COMMENTS
		VERTICAL	TIES	
MC-1	8" x 24"	(3) #5	#2 AT 8" O.C.	
MC-2	8" x 32"	(8) #5	#2 AT 8" O.C.	

MASONRY COLUMN NOTES:

1. THE CENTERLINE OF VERTICAL BARS SHALL BE LOCATED 2 1/2" FROM THE FACE OF THE MASONRY. HORIZONTAL WALL REINFORCEMENT SHALL BE LOCATED TO THE INSIDE OF VERTICAL BARS.
2. UNLESS NOTED OTHERWISE, VERTICAL REINFORCING AND TIES SHALL EXTEND TO FULL WALL HEIGHT.
3. VERTICAL MASONRY COLUMN REINFORCING SHALL EXTEND INTO THE FOOTING AND TERMINATE WITH A STANDARD 90° HOOK. FOR CONCRETE FOUNDATION WALLS OVER 5'-0" TALL, VERTICAL COLUMN REINFORCING REINFORCING SHALL DOWEL 4'-0" MINIMUM INTO THE FOUNDATION WALL.
4. IN CONCRETE FOUNDATION WALLS, VERTICAL MASONRY COLUMN REINFORCING SHALL BE TIED WITH #3 TIES AT THE SAME SPACING AND CONFIGURATION AS MASONRY COLUMNS ABOVE.
5. SEE GENERAL STRUCTURAL NOTES FOR ALL OTHER REQUIREMENTS.



COLUMN CONFIGURATION SCHEMATIC FOR MASONRY COLUMNS

5 MASONRY COLUMN SCHEDULE

NO SCALE

ARCHITECTURAL SCHEDULES

ABBREVIATIONS

Standard Abbreviations

A

Abbreviation	Term	Abbreviation	Term
ABAN	abandon	AABRV	abbreviation
AFF	above finished floor	AFG	above finished grade
AFS	above finished slab	ASC	above suspended ceiling
ABSORB	absorption	ACS DR	access door
ACS FLR	access floor	ACS PNL	access panel
ACC	accessible	pH	acid/alkaline scale
ACID RES	acid resistant	ACST	acoustic
ACR	across	ADDM	addendum
ADDL	additional	ADH	adhesive
ADJ	adjacent	ADMIN	administration
AGGR	aggregate	A/C	air condition
A/C UNIT	air conditioning unit	AHU	air handling unit
ALM	alarm	ALNMT	alignment
ALLOW	allowance	ALT	alternate
ALT NO	alternate number	AC	alternating current
ALUM	aluminum	AMB	ambient
AAMA	American Architectural Manufacturers Association	AACE	American Association of Cost Engineers
ACI	American Concrete Institute	AGA	American Gas Association
AIA	American Institute of Architects	AISC	American Institute of Steel Construction
ANSI	American National Standards Institute	APA	American Plywood Association
ASTM	American Society for Testing and Materials	ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers	ASME	American Society of Mechanical Engineers
ASEC	American Standard Elevator Codes	ASWG	American steel wire gauge
AWWA	American Water Works Association	AWS	American Welding Society
AWG	American wire gauge	AWPA	American Wood Preserver's Association
ADA	Americans with Disabilities Act	AMT	amount
AMP	ampere	ETC	and so forth
L	angle	ANOD	anodize
ANT	antenna	APT	apartment
APP	appearance	APPX	appendix
APPD	approved	APPROX	approximate
ARCH	architect	A/E	architect/engineer
ASI	Architect's Supplemental Instruction	AWI	Architectural Woodworking Institute
ASB	asbestos	ASPH	asphalt
AI	Asphalt Institute	ASSY	assembly
ABC	Associated Builders and Contractors	AGC	Associated General Contractors
ASSN	association	ASYM	asymmetrical
ATCH	attachment	ATTN	attention
AV	audio visual	AHJ	authority having jurisdiction
AUTO	automatic	ATM	automatic teller machine
AUX	auxiliary	AVE	avenue
AVG	average	AZ	azimuth

Standard Abbreviations

B

Abbreviation	Term	Abbreviation	Term
BC	back of curb	B/B	back to back
BKG	backing	BAL	balance
BLST	ballast	BSMT	basement
BATT	batt insulation	BM	beam
WF BM	beam, wide flange	BRG	bearing
BR	bedroom	BLW	below
BFF	below finish floor	BTR	better
BTWN	between	BEV	bevel
BI FLD DR	bi-folding doors	BITUM	bituminous
BLK	block	BD	board
BD FT	board feet (foot)	BNDG	bonding
BOT	bottom	BOS	bottom of steel
BLVD	boulevard	BDRY	boundary
BRCG	bracing	BRKT	bracket
BIA	Brick Institute of America	BRDG	bridging
BRDG JST	bridging joist	Btu	British thermal unit
MBtu	British thermal unit (1000)	BtuH	British thermal unit per hour
BRZ	bronze	BLD	build
BHMA	Builder's Hardware Manufacturer's Association	BLDG	building
BOCA	Building Officials and Code Administrators Association International	BLT	built
BLT IN	built-in	BUR	built-up roofing
BPRF	bulletproof (bullet-resistant)	BT WLD	butt weld

Standard Abbreviations

C

Abbreviation	Term	Abbreviation	Term
CAB	cabinet	CTV	cable television
CALC	calculate	CANTIL	cantilever
CO^2	carbon dioxide	CPT	carpet
CSWK	casework	CAT	catalog
CLG	ceiling	CAC	ceiling attenuation class
CLG HT	ceiling height	CEM	cement
CTR	center	CL	center line
C TO C	center to center	CM	centimeter
CM/S	centimeter per second	CER	ceramic
CTB	ceramic tile base	CTF	ceramic tile floor
CTI	Ceramic Tile Institute of America	CLFMI	Chain Link Fence Manufacturer's Institute
CH BD	chalk board	CHFR	chamfer
C	channel	CFC	chlorofluorocarbons
CIR	circle	CRCMF	circumference
CLDG	cladding	CLASS	classification
CLRM	classroom	CLR	clear
CLWG	clear wired glass	CCTV	closed circuit television
CLO	closet	CLOS	closure
CTD	coated	CTG	coating
COAX	coaxial cable	COEFF	coefficient
CFMF	cold formed metal framing	CRS	cold rolled steel
CW	cold water piping	COL	column
COMB	combination, combined	COM	common
COMM	communication	CATV	community antenna television
COMPL	complete	COMP	component
CMPST	composite	CPRS	compressible
COMPR	compressor	CMPTR	computer
CNCL	concealed	CONC	concrete
CONC FLR	concrete floor	CMU	concrete masonry unit
CONC OPNG	concrete opening	CRSI	Concrete Reinforcing Steel Institute
COND	condition	CONF	conference
CONSTR	construction	CSI	Construction Specifications Institute
CONSULT	consultant	CONT	continue
CONTR	contract	CCD	contract change directive
CF	contractor furnished	CFE	contractor furnished equipment
CF/CI	contractor furnished/contractor installed	CF/OI	contractor furnished/owner installed
CTRL	control	CONV	convert
CNVR	conveyor	COORD	coordinate
CU	cubic	CNR	corner
CORN	cornice	CORRES	correspond
CORR	corridor	CT	count
CNTR	counter	CSK	counter sunk
CCW	counterclockwise	CFLG	counter flashing
CPLG	coupling	CRT YD	court yard
COV	cover	COV PL	cover plate

Standard Abbreviations

C

Abbreviation	Term
CPM	critical path method
X SECT	cross section
CRN	crown
CU FT	cubic feet
CFS	cubic feet per second
M^3	cubic meter
MM^3	cubic millimeter
C&G	curb and gutter
CUST	custodian
KA	cylinder locks keyed alike

Abbreviation	Term
X BRACE	cross brace
X BRA	crossbracing
CM^3	cubic centimeter
CFM	cubic feet per minute
CU IN	cubic inch
M^3/S	cubic meter per second
CU YD	cubic yard
CURT	curtain
CYL	cylinder

Standard Abbreviations

D

Abbreviation	Term	Abbreviation	Term
DMPR	damper	DAT	datum
DL	dead load	Db	decibel
DG	decigram	dL	deciliter
DM	decimeter	DEF	definition
DFLCT	deflection	DEG	degree
DEG C	degrees Celsius	DEG F	degrees Fahrenheit
DRW	deionized water	DEL	delete
DEMO	demolition	DENS	density
DEPT	department	DESCR	description
DSGN	design	D-B	design-build
DES	designation	DTCH	detach
DET	detail	DETN	detention
DEV	development	DIAG	diagram
DIA	diameter	DIFF	diffuser
DIM	dimension	DC	direct current
DIR	direction	DSBL	disable
DA	disabled	DISCH	discharge
DISP	dispenser	DSPL	disposal
DIST	distance	DIV	divide
DOC	document	DHW	domestic hot water
DW	domestic water	DR	door
DR CL	door closer	DR FR	door frame
DHI	Door Hardware Institute	DRH	door holder
DRLV	door louver	DR OPNG	door opening
DRST	door stop	DRSW	door switch
DBL	double	DBL ACT DR	double acting door
XXH	double extra heavy	DBL GLZ	double glaze
DS	double strength (glass)	DOUG FIR	douglas fir
DVTL	dove tail	DOZ	dozen
DFTG	drafting	DWR	drawer
DWG	drawing	D4S	dressed four sides
D1S	dressed one side	D2S	dressed two sides
DR AREA	dressing area	DF	drinking fountain
DF WL MTD	drinking fountain, wall mounted	DB	dry bulb
DBT	dry bulb temperature	D CHEM	dry chemical
DUPL	duplicate	DT DR	dutch door

Standard Abbreviations

E

Abbreviation	Term	Abbreviation	Term
EA	each	ESMT	easement
E	east	EOS	edge of slab
EFF	efficiency	ELAST	elastomeric
ELEC	electric	ELEC DR OP	electric door opener
EHD	electric hand dryer	EH	electric heater
EWC	electric water cooler	EWH	electric water heater
ELEM	element	EL	elevation
ELEV	elevator	EMER	emergency
EPO	emergency power off	ENCL	enclosure
ENGR	engineer	EWA	Engineered Wood Association
EJCDC	Engineers Joint Contract Documents Committee	EPA	Environmental Protection Agency
EQ	equal	EQL SP	equally spaced
EQUIP	equipment	EQUIV	equivalent
ESCAL	escalator	ESC	escutcheon
ESP	especially	ESTB	establish
EST	estimate	ETC	et cetera
EPDM	ethylene propylene diene monomer	EVAC	evacuate
EX	example	EXEC	execute
EXH	exhaust	EXH A	exhaust air
EXIST	existing	EXST GR	existing grade
EXT LT	exit light	EPS	expanded polystyrene board (insulation)
EXP	expansion	EXP BT	expansion bolt
EJ	expansion joint	EXTN	extension
EXT	exterior	EXT GR	exterior grade
EIFS	exterior insulation and finish system	XL	extra large
XPS	extruded polystyrene board (insulation)	EXTRU	extrusion
EWS	eye wash station		

Standard Abbreviations

F

Abbreviation	Term	Abbreviation	Term
FAB	fabric	FC BRK	face brick
FOF	face of finish	FOS	face of slab
FOW	face of wall	F/F	face to face
FTD	facial tissue dispenser	FACIL	facility
FAX	facsimile	FAC	factor
FCTY	factory	F	Fahrenheit
FCU	fan coil unit	FAS BD	fascia board
FSTNR	fastener	FED	federal
FEA	Federal Energy Administration	FHWA	Federal Highway Administration
FHA	Federal Housing Administration	FDBK	feedback
FT	feet	FPM	feet per minute
FPS	feet per second	FN	fence
FRG	fiber reinforced gypsum	FGL	fiberglass
FIG	figure	FIL	fillet
FLTR	filter	FNGR JT	finger joint
FIN	finish	FIN BS	finish both sides
FF	finish face	FIN FLR	finish floor
FF EL	finish floor elevation	F4S	finish four sides
FIN GR	finish grade	F2S	finish two sides
FIN WD	finish wood	F1S	finished one side
FO	finished opening	FAAP	fire alarm annunciator panel
FABL	fire alarm bell	FABX	fire alarm box
FACP	fire alarm control panel	FBRK	fire brick
FDMPR	fire damper	FDC	fire department connection
FDCC	fire department connection cabinet	FDV	fire department valve
FDR	fire door	FE	fire extinguisher
FEC	fire extinguisher cabinet	FHC	fire hose cabinet
FHR	fire hose rack	FH	fire hydrant
FP	fire protection	FRA	fire rated assembly
FRTW	fire retardant treated wood	FSH	fire sprinkler head
FSP	fire standpipe	FPL	fireplace
FIXT	fixture	FLMB	flammable
FLG	flange	FLASH	flashing
FHMS	flat head machine screw	FHWS	flat head wood screw
FLEX	flexible	FL FIN CONC	float finish concrete
FLT GL	float glass	FLT	floodlight
FLR	floor	FAR	floor area ratio
FD	floor drain	FLR FIN	floor finish
FLR PL	floor plate	FLR REG	floor register
FLR SK	floor sink	FL	floor line
FL OZ	fluid ounce	FLUOR	fluorescent
FLOUR FIX	fluorescent fixture	LT FLUOR	fluorescent lighting
FLMT	flush mount	FLUT CMU	fluted concrete masonry unit
FLUT	fluting	FF BATT	foil backed batt insulation
FF INSUL	foil backed insulation	FLDG	folding

Standard Abbreviations

F

Abbreviation	Term
FBM	foot board measure
FT/LBF	foot/pound force
FTG	footing
FWRK	formwork
FOUNT	fountain
FR MIR/SHF	framed mirror and shelf
FRWY	freeway
FRT	freight
FAI	fresh air inlet (intake)
FFA	from floor above
FRST GL	frosted glass
FF&E	furniture, fixture, and equipment
FUT	future

Abbreviation	Term
FT/LB	foot/pound
FC	foot-candle
FMBD	form board
FDTN	foundation
FR MIR	framed mirror
FRMG	framing
FRZ	freezer
FREQ	frequency
FR GL	fritted glass
FFB	from floor below
FHP	full height partition
FURG	furring

Standard Abbreviations

G

Abbreviation	Term	Abbreviation	Term
GA	gage	GAL	gallon
GPD	gallons per day	GPH	gallons per hour
SGPH	Gallons Per Hour, Standard	GPM	gallons per minute
GPS	gallons per second	GALV	galvanized
GSM	galvanized sheet metal	GALV STL	galvanized steel
G DISP	garbage disposal	GRDN	garden
GWH	gas fired water heater	GVTR	gas vent through roof
GEN COND	general conditions	GC	general contractor
GEN PURP	general purpose	GEN	generator
GL BLK	glass block	GFRC	glass-fiber-reinforced concrete
GFRG	glass-fiber-reinforced gypsum	GLZ CMU	glazed concrete masonry unit
GSU	glazed structural unit	GWT	glazed wall tile
GLZ	glazing	GLU LAM	glued laminated wood
GOVT	government	GB	grab bar
GR BM	grade beam	GR LN	grade line
GRAD	gradient	GMK	grand master key
GMKD	grand master keyed	GRAN	granite
GRTG	grating	GRL	grille
GROM	grommet	GR	gross
GR WT	gross weight	GFCI	ground fault circuit interrupter
GR FL	ground floor	GL	ground level
GP	group	GUAR	guarantee
GMP	guaranteed maximum price	GD	guard
GDR	guard rail	GUT	gutter
GYM	gymnasium	GYP BD	gypsum board
GYP	gypsum	GYP PLAS	gypsum plaster
GPC	gypsum plaster ceiling	GSB	gypsum sheathing board

Standard Abbreviations

H

Abbreviation	Term
HMR	hammer
HC	handicap
HNDRL	handrail
HDBD	hardboard
HDW	hardware
HAZ	hazard
HD JT	head joint
HQ	headquarters
HAGL	heat absorbing glass
HVAC	heating, ventilating, and air conditioning
HA	hectare
HM	hectometer
HEM	hemlock
HEX	hexagon
HDPE	high density polyethylene
HF	high frequency
HPF	high power factor
HPLAM	high pressure plastic laminate
HST	hoist
HLDN	hold down
CCF	hundred cubic feet
HYD	hydrant
HCFC	hydrochlorofluorocarbons

Abbreviation	Term
HD	hand dryer
HCP	handicapped
HGR	hanger
HDNR	hardener
HDWD	hardwood
HAZ MAT	hazardous materials
HDR	header
HDWL	headwall
HT TRD	heat treated (glass)
HVY	heavy
hL	hectoliter
HT	height
Hz	hertz
HDO	high density overlay
HEPA	high efficiency particulate air (filter)
HID	high intensity discharge
HPG	high pressure gas
HWY	highway
HO	hold open
HMD	humidity
CWT	hundred weight
HYDR	hydraulic

Standard Abbreviations

I

Abbreviation	Term	Abbreviation	Term
IB	I beam	ID	identification
ID NO	identification number	ILLUM	illumination
IESNA	Illumination Engineering Society of North America	ILLUS	illustrate
IMED	immediate	IIC	impact isolation class
INR	impact noise rating	INCAND	incandescent
IN-LB	inch-pound	IN-LBF	inch-pound force
IN/S	inches per second	IN WC	inches, water column
INCIN	incinerator	INCL	included
INC	increase	INCR	increment
IAQ	indoor air quality	INFO	information
IR	infrared	I/O	input/output
IFS	inside face of stud	INSP	inspect
INSTL	install	INSTR	instrument
INSUF	insufficient	INSUL PNL	insulated metal panel
INSUL	insulation	INS	insurance
INTERCOM	intercommunication	INT	interior
INTL	international	IBC	International Building Code
IPS	international pipe standard	ISO	International Standards Organization
SI	International System of Units	I	interstate (highway)
ITS	Intertek Testing Services	INV	invert
INV EL	invert elevation	IRMA	inverted roof membrane assembly
IRREG	irregular	IW	irrigation water
IS	island		

Standard Abbreviations

J

Abbreviation	Term
JAL	jalousie
JAN CLO	janitor closet
J-BOX	junction box
JAN	janitor
JS	janitor's sink
JR	junior

K

Abbreviation	Term
K	Kelvin
KPL	kickplate
kCAL	kilocalorie
kHz	kilohertz
km	kilometer
km/s	kilometers per second
kV	kilovolt
kVAh	kilovolt ampere per hour
kW	kilowatt
kWhm	kilowatt hour meter
KSF	kips per square foot
KIT	kitchen
KOP	knock out panel
KO	knockout
KWY	keyway
k	kilo
kg	kilogram
kL	kiloliter
km/h	kilometers per hour
kPa	kilopascal
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kWh	kilowatt hour
KLF	kips per lineal foot
KSI	kips per square inch
KB	knee brace
KD	knocked down

Standard Abbreviations

L

Abbreviation	Term	Abbreviation	Term
LAB	laboratory	LAQ	lacquer
LAD	ladder	LAG	lagging
L COL	lally column	LAM	laminate
LAM GL	laminated glass	LDG	landing
LDMK	landmark	LNDSCP	landscape
LN	lane	LRG	large
L&L	latch and lock	LATL	lateral
L&P	lath and plaster	LAT	latitude
LANH	launch	LAU	laundry
LAV	lavatory	LYR	layer
LYT	layout	LL GB	lead lined gypsum board
LDR	leader	LH	left hand
LHR	left hand reverse	LHS	left hand side
LIB	library	LT	light
LT GA	light gage	LTG	lighting
LTG PNL	lighting panel	LTNG	lightning
LPL	lightproof louver	LPV	lightproof vent
LT WT	lightweight	LWC	lightweight concrete
LCMU	lightweight concrete masonry unit	LWIC	lightweight insulating concrete
LW PLAS	lightweight plaster	LMST	limestone
LTD	limited	LOS	line of sight
LIN	linear	LCD	linear ceiling diffuser
LD	linear diffuser	LF	linear feet (foot)
L CL	linen closet	LINO	linoleum
LIQ	liquid	LG	liquid gas
LOX	liquid oxygen	LP	liquid petroleum
LPG	liquid petroleum gas	L/s	liter per second
LL	live load	LR	living room
LD BRG	load-bearing	LOC	location
LO	lock on	LRA	locked rotor amps
LKR	locker	LKR RM	locker room
LKNT	locknut	LKWASH	lockwasher
LLH	long leg horizontal	LLV	long leg vertical
LNG	longitude	LONG	longitudinal
LF INS	loose fill insulation	LVR	louver
LVDR	louver door	LVD	louvered
LRV	louvered roof vent	LDPE	low density polyethylene
LPT	low point	LUB	lubricate
LBR	lumber	LS	lump sum

Standard Abbreviations

M

Abbreviation	Term	Abbreviation	Term
MACH	machine	MB	machine bolt
MACH RM	machine room	MS	machine screw
MAG	magnet	MN	magnetic north
MAHOG	mahogany	MCH	mail chute
MAINT	maintenance	MAU	make up air unit
MGT	management	MH	manhole
MAN	manual	MFD	manufactured
MFR	manufacturer	MFR REC	manufacturer's recommendation
MFG	manufacturing	MFMA	Maple Flooring Manufacturers Association
MRB	marble base	MRF	marble floor
MIA	Marble Institute of America	MRT	marble threshold
MKR	marker	MATV	master antenna television system
MKD	master keyed	MHD	masthead
MATL	material	MTX	matrix
MAX	maximum	MSL	mean sea level
MEAS	measure	MECH	mechanical
ME	mechanical engineer	MECH RM	mechanical room
MED	medium	MDO	medium density overlay
MTG	meeting	MHz	megahertz
MVA	megavolt-ampere	MWh	megawatt hour
MEL	melamine	MBR	member
MEMB	membrane	MWP	membrane waterproofing
MEMO	memorandum	Hg	mercury
MER	meridian	MTL	metal
METB	metal base	MCB	metal corner bead
MD	metal deck	METD	metal door
METF	metal flashing	ML	metal lath
ML&P	metal lath and plaster	METP	metal partition
METR	metal roof	m	meter
m/s	meters per second	MEZZ	mezzanine
MIC	microphone	MID	middle
MPG	miles per gallon	MPH	miles per hour
MIL STD	military standard	mm	millimeter
MGD	million gallons per day	ms	millisecond
MLWK	millwork	MIN	minimum
MIRR	mirror	MISC	miscellaneous
MIT	miter	MOD BIT	modified bitumen
MOD	modify	MSTRE	moisture
MR	moisture resistant	MLDG	molding (moulding)
MOPR	mop rack	MSB	mop service basin
MBH	mop/broom holder	MTD	mounted
MULL	mullion	MULT	multiple
MZ	multizone	MUNIC	municipal

Standard Abbreviations

N

Abbreviation	Term	Abbreviation	Term
NAR	narrow	NATL	national
NAAMM	National Association of Architectural Metal Manufacturers	NBC	National Building Code
NBS	National Bureau of Standards	NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association	NFRC	National Fenestration Rating Council
NFC	National Fire Code	NFPA	National Fire Protection Association
NIBS	National Institute of Building Sciences	NIST	National Institute of Standards and Technology
NPCA	National Paint and Coatings Association	NRCA	National Roofing Contractors Association
NAT	natural	G	natural gas
NF	near face	NS	near side
NEG	negative	NEGTD	negotiated
NT WT	net weight	NEUT	neutral
NKL	nickel	NICOP	nickel copper
NCA	nickel copper alloy	NPL	nickel plated
NI SIL	nickel silver	NL	night light
NP	no paint	NC	noise criteria
NR	noise reduction	NRC	noise reduction coefficient
NOM	nominal	NM	non-metallic
NRCP	non-reinforced concrete pipe	NCOMBL	noncombustible
NONFLMB	nonflammable	NFSD	nonfused
NLB	non-loadbearing	NMAG	nonmagnetic
NRP	nonremovable	NON STD	nonstandard
NORM	normal	N	north
NA	non applicable	NE	not exceeding
NIC	not in contract	NTS	not to scale
NOC	notice of clarification	NTP	notice to proceed
NO	number	NUM	numeral

Standard Abbreviations

O

Abbreviation	Term	Abbreviation	Term
OGL	obscure glass	OWGL	obscure wired glass
OBW	observation window	OSHA	Occupational Safety and Health Administration
OCC	occupy	OCT	octagon
OFF	office	OC	on center
MGPH	one thousand gallons per hour	MSF	one thousand square feet
1WAY	one-way	OPQ	opaque
OPNG	opening	OPR	operable
OPP	opposite	OPH	opposite hand
OPT	optional	ORD	ordnance
ORG	organic	ORIG	original
ORN	ornamental	OZ	ounce
O/O	out to out	OUT	outlet
OF	outside face	OFS	outside face of studs
OR	outside radius	O/	over
OA	overall	OVFL	overflow
OFD	overflow drain	OH	overhang
OH DR	overhead (coiling) door	OL	overload
OVRD	override	OF/CI	owner furnished/contractor installed
OF/OI	owner furnished/owner installed	O	oxygen

Standard Abbreviations

P

Abbreviation	Term	Abbreviation	Term
PKG	package	PMET	painted metal
PDCA	Painting and Decorating Contractors of America	PR	pair
PNL	panel	PANB	panic bolt
PCD	paper cup dispenser	PTD	paper towel dispenser
PTDR	paper towel dispenser and receptacle	PTR	paper towel receptacle
PARA	paragraph	PAR	parallel
PAREN	parenthesis	PARG	parking
PRKG	parking	PK GAR	parking garage
PK LOT	parking lot	PKWY	parkway
PN	part number	PART	partial
PBD	particleboard	PTN	partition
PPM	parts per million	Pa	Pascal
PW	pass window	PASS	passenger
PAT	pattern	PV	paved
PV RD	paved road	PVG	paving
PED	pedestal	PGBD	pegboard
PEND	pendant	PEN	penetrate
PCT	percent	PERF	perforated
PERIM	perimeter	PER	period
PERM	permanent	PERP	perpendicular
PETRO	petroleum	PHAR	pharmacy
PH	phase	PHS	Phillips head screw
PEC	photoelectric cell	PHOTO	photograph
PC	piece	PIL	pilaster
PLG	piling	PSL	pipe sleeve
PIV	pivoted	PLC	place
PMBC	plant mix bituminous concrete	PLAS	plaster
PLST WL	plaster wall	PLAM	plastic laminate
PL GL	plate glass	PLAT	platform
PLB	plumb	PLBG	plumbing
PLYWD	plywood	PNEU	pneumatic
PI	point of intersection	POL	polished
PPGL	polished plate glass	PCB	polychlorinated biphenyl
POLY	polyethylene (plastic)	PIB	polyisobutylene (plastic)
PS	polystyrene (plastic)	PVA	polyvinyl acetate
PVC	polyvinyl chloride (plastic)	PVF	polyvinyl fluoride (plastic)
PORC	porcelain	PORT	portable
PCA	Portland Cement Association	PCP	portland cement plaster
POS	positive	PT	post-tensioned
PT CONC	post-tensioned concrete	POTW	potable water
LB	pound	LBF	pound-force
LBF/CF	pound-force per cubic foot	LBF/FT	pound-force per foot
LBF/HP	pound-force per horsepower	LBF/H	pound-force per hour
LBF/IN	pound-force per inch	LBF/MIN	pound-force per minute

Standard Abbreviations

P

Abbreviation	Term	Abbreviation	Term
LBF/SF	pound-force per square foot	LBF/SI	pound-force per square inch
PCF	pounds per cubic foot	PLF	pounds per linear foot
PSF	pounds per square foot	PSI	pounds per square inch
PSIA	pounds per square inch absolute	PSIG	pounds per square inch, gage
PWR	power	PF	power factor
POW LN	power line	PRE	power roof exhaust
PRCST	precast	PCC	precast concrete
PCI	Precast/Prestressed Concrete Institute	PREFAB	prefabricate
PREF	preference	PREFIN	prefinish
PREFMD	preformed	PRELIM	preliminary
PRMLD	pre-molded	PEJ	premolded expansion joint
PREP	preparation	PS CONC	prestressed concrete
PREV	previous	PRI	primary
PRIN	principal	PMF	probable maximum flood
PMP	probable maximum precipitation	PROD	production
PROJ	project	PROP	property
PL	property line	PROV	provisional
PA	public address	PO	purchase order
PUR	purlins	PSH	purse shelf
PRD	push rod	PP PL	push/pull plate

Standard Abbreviations

Q

Abbreviation	Term	Abbreviation	Term
QUAD	quadrant	QUAL	quality
QA	quality assurance	QC	quality control
QCR	quality control review	QM	quality management
QTY	quantity	QRY	quarry
QT	quarry tile	QTB	quarry tile base
QTF	quarry tile floor	QTR	quarter
QUOT	quotation		

R

Abbreviation	Term	Abbreviation	Term
RAB	rabbeted	RADN	radiation
RAD HAZ	radiation hazard	RAD	radiator
R	radius	RLG	railing
RR	railroad	RWL	rain water leader
RTG	rating	RECD	received
RCPTN	reception	REC	recessed
RWR	recessed waste receptacle	RECIP	reciprocal
RECIRC	re-circulate	REC ROOM	recreation room
RECT	rectangle	RWD	redwood
REFL	reflect	REFR	refractory
REF	refrigerator	REG	regulation
REINF	reinforce	RBM	reinforced brick masonry
RC	reinforced concrete	RCB	reinforced concrete box
RCCP	reinforced concrete culvert pipe	RCP	reinforced concrete pipe
RST	reinforcing steel	REBAR	reinforcing steel bars
REPL	replace	REPRO	reproduce
RFI	request for information	RFP	request for proposal
REQ	require	REQD	required
R&D	research and development	RESIL	resilient
REST	restroom	RVL	reveal
RVS	reverse	REV	revision
RT	right	RH	right hand
RHR	right hand reverse	ROW	right of way
RDG INS	rigid insulation, solid	RD	road
RW	roadway	RB HK	robe hook
RFG	roofing	RM	room
RO	rough opening	RS	rough sawn
RND	round	RHMS	round head machine screw
RHWS	round head wood screw	RBR	rubber
RTF	rubber tile floor	RWY	runway

Standard Abbreviations

S

Abbreviation	Term	Abbreviation	Term
SDL	saddle	SALV	salvage
SAMP	sample	SDBL	sandblast
SAN	sanitary	SND	sanitary napkin dispenser
SNDU	sanitary napkin disposal unit	SAT	saturate
SCHED	schedule	SCHEM	schematic
SCHED	school	SJ	scored joint
SCRN	screen	SCP	scupper
SL	sea level	SLNT	sealant
SMLS	seamless	SCD	seat cover dispenser
SHWR	secondary hot water return	SHWS	secondary hot water supply
SECT	section	SEG	segment
SEL	select	SHG	sensible heat gain
SNSR	sensor	SEP	separate
SEP TNK	septic tank	SVCE	service
SWG	sewage	SWR	sewer
SHT	shaft	SHFT	shaft (elevator)
SFT HP	shaft horsepower	SHTHG	sheathing
SHT MTL FLASH	sheet metal (flashing)	SV	sheet vinyl
SHV	shelving	SCC	short circuit capacity
SHLDR	shoulder	SHR	shower
SCR	shower curtain rod	SHRD	shower drain
SHR HD	shower head	SHTR	shutter
SDG	siding	SIG	signal
GM	silty gravel	SIM	similar
SGL	single	1PH	single phase
1P	single pole	SPDT	single pole, double throw
SPST	single pole, single throw	FLOUTS	single receptacle floor outlet
SOUT	single receptacle outlet	SK	sketch
SKLT	skylight	SLV	sleeve
SLDG	sliding	SGD	sliding glass door
SM	small	SMK	smoke
SDMPR	smoke damper	SD	smoke detector
SARA	Society of Registered Architects	SFTWD	soft wood
SLDR	solder	SOLV	solenoid valve
SCMU	solid concrete masonry unit	SCWD	solid core wood door
SOLN	solution	SLVT	solvent
SND INS	sound insulation	STC	sound transmission class
S	south	SBCCI	Southern Building Code Congress International
SPH	space heater	SPKR	speaker
SPCL	special	SP FIN	special finish
SP GR	specific gravity	SPEC	specification
SB	splash block	SPL	spline
SP EL	spot elevation	SPKLR	sprinkler
SPR	sprinkler line	SPF	spruce-pine-fir
SQ	square	SQ BR	square bar

Standard Abbreviations

S

Abbreviation	Term	Abbreviation	Term
cm^2	square centimeter, centimeter squared	SF	square foot (feet)
SQ IN	square inch	km^2	square kilometer
m^2	square meter	mm^2	square millimeter
SQ YD	square yard	STAG	staggered
ST GL	stained glass	STNLS	stainless
SST	stainless steel	SSP	stainless steel pipe
STD	standard	SCFM	standard cubic feet per minute
SCFS	standard cubic feet per second	STP	standard temperature and pressure
SP	standpipe	S/S	start/stop
ST PR	static pressure	STA	station
STM	steam	SG	steam gage
ST GEN	steam generator	SMH	steam manhole
SR	steam return	STWP	steam working pressure
STL JST	steel joist	SJI	Steel Joist Institute
STL LNTL	steel lintel	STL PL	steel plate
STL RF DK	steel roof deck	STL TR	steel truss
STL TB	steel tube	SWI	Steel Window Institute
STPG	stepping	STIF	stiffener
STIR	stirrup	STOR	storage
STRM	storeroom	SD	storm drain
SDMH	storm drain manhole	ST W	storm water
STR	straight	STN	strainer
ST	street	STRB	strobe
STRB/HRN	strobe/horn	STRUCT	structural
SCT	structural clay tile	SE	structural engineer
STRUCT STL	structural steel	SBS	styrene butadiene styrene
SUB FL	subfloor	SUBPAR	subparagraph
SSD	subsoil drain	SUB	substitute
SBSTR	substrate	SUCT	suction
SUF	sufficient	SUM	summary
SMP	sump pump	SUTK	sump tank
SUPVR	supervisor	SUPPL	supplement
SUP	supplementary	SPLY	supply
SA	supply air	SAG	supply air grille
SPRT	support	SUPN	suppression
SURF	surface	S4S	surfaced four sides
S!S	surfaced one side	S2S	surfaced two sides
SURR	surround	SURV CAM	surveillance camera
SURV EQUIP	surveillance equipment	SURV MON	surveillance monitor
SURV	survey	SUSP	suspend
SAPC	suspended acoustical plaster ceiling	SATC	suspended acoustical tile ceiling
SUSP CLG	suspended ceiling	SPC	suspended plaster ceiling
SUH	suspended unit heater	SWDR	swing door
SWBD	switchboard	SWGR	switchgear
SYM	symbol	SYMM	symmetrical

Standard Abbreviations

S

Abbreviation	Term
SYNTH	synthetic

Abbreviation	Term

Standard Abbreviations

T

Abbreviation	Term	Abbreviation	Term
TOC	table of content	TAB	tabulate
TK BD	tack board	TAN	tangent
TECH	technical	TEL	telephone
FOUTT	telephone floor outlet	TEL JK	telephone jack
TEL OUT	telephone outlet	TP	telephone pole
TTB	telephone terminal board	TV	television
TVOUT	television outlet	T&P VALVE	temperature and pressure valve
TCV	temperature control valve	TMPD	tempered
TMPD GL	tempered glass	TEMP HDBD	tempered hardboard
TEMP	temporary	TBM	temporary benchmark
TERM	terminal	TUC	terminal unit controller
TC	terra cotta	TER	terrazzo
TB-xx	test boring-xx (e.g. TB-01)	THERM	thermal
C VALVE	thermal conductance	K VALVE	thermal conductivity
TSTAT	thermostat	THK	thickness
MBF	thousand board feet	MBtuH	thousand Btu per hour
MCF	thousand cubic feet	MBM	thousand feet board measure
KIP FT	thousand foot/pounds	KIP	thousand pounds
THD	thread	3/C	three-conductor
3PH	three-phase	3PLY	three-ply
3WAY	three-way	THRES	threshold
THRU	through	TB	through bolt
THRUOUT	throughout	TCA	Tile Council of America
T&M	time and materials	TFA	to floor above
TFB	to floor below	TPD	toilet paper dispenser
TPH	toilet paper holder	TOL	tolerance
T&G	tongue and groove	T&B	top and bottom
TE	top elevation	TO	top of
TOB	top of beam	TOC FTG	top of concrete footing
TOC WALL	top of concrete wall	TFF	top of finish floor
TOF	top of footing	TO FDN	top of foundation
TOJ	top of joist	TMH	top of manhole
TOM	top of masonry	TOP	top of parapet
TOS	top of slab	TOT	top of truss
TOW	top of wall	TOPO	topography
THD	total dynamic head	TQM	total quality management
TDR	towel dispenser/receptacle	TSH	towel shelf
XFER	transfer	TG	transfer grille
XFMR	transformer	TRANS	transparent
TRANS WD FIN	transparent wood finish	TEJ	transverse expansion joint
T	tread	TRTD	treated
TWR	treated water return	TWS	treated water supply
TN	true north	T/S	tub/shower
TS	tube steel	TNL	tunnel
TRNBKL	turnbuckle	TNPK	turnpike

Standard Abbreviations

T

Abbreviation	Term
TL	twist lock
2/C	two-conductor
TYP	typical

Abbreviation	Term
TPS	twisted pair shielded
2WAY	two-way

Standard Abbreviations

U

Abbreviation	Term
ULT	ultimate
UC	undercut
UFD	underfloor duct
UL	Underwriters Laboratories
UNFIN	unfinish
UBC	Uniform Building Code
UMC	Uniform Mechanical Code
UPS	uninterruptible power supply
dBA	unit of sound level
UNIV	universal
UNO	unless noted otherwise
UNPV RD	unpaved road
UR	urinal
UPS	utility pole

Abbreviation	Term
UV	ultraviolet
UCD	undercut door
UGND	underground
UNEX	unexcavated
UNIF	uniform
UFC	Uniform Fire Code
UPC	Uniform Plumbing Code
UH	unit heater
UWT	unit weight
UN	unless noted
UON	unless otherwise noted
UTP	untwisted pair
UTIL	utility

Standard Abbreviations

V

Abbreviation	Term
VJ	V joint
VCO	vacuum cleaner outlet
VAN	vanity
VAP PRF	vapor proof
VF	variable frequency
VAR	varies
VEL	velocity
VTR	vent through roof
VRNDA	veranda
VIF	verify in field
VC	vertical curve
VUH	vertical unit heater
VHO	very high output
VIB	vibration
VID	video
VINT	video integration
VB	vinyl base
VFAT	vinyl faced acoustical tile
VWF	vinyl wall fabric
VIS	visual
VOC	volatile organic compound
VAM	volt-ammeter
VOLT	voltage
VRLY	voltage relay
VOL	volume
VFR	volumetric flow rate

Abbreviation	Term
VAC	vacuum
VRP	vacuum return pump
VAP BARR	vapor barrier
VAV	variable air volume
VFD	variable frequency drive
VEH	vehicle
VNR	veneer
VENT	ventilation
VRFY	verify
VERT	vertical
VG	vertical grain
VHF	very high frequency
VEST	vestibule
VIC	vicinity
VIDAMP	video amplifier
VIL	village
VCT	vinyl composite tile
VWC	vinyl wall covering
VISC	viscosity
VIT	vitreous
V	volt
VA	volt ampere
VR	voltage regulator
VS	voltmeter switch
VD	volume damper

Standard Abbreviations

W

Abbreviation	Term	Abbreviation	Term
WSCT	wainscot	WAU	wall ash urn
W CAB	wall cabinets	WCO	wall cleanout
WFAB	wall fabric	W/W	wall to wall
WHSE	warehouse	WARR	warranty
WDSP	waste disposer	WRT	water
WCHR	water chiller	WC	water closet
WC WL HNG	water closet, wall hung	WCLD	water cooled
WCRL	water cooler	WCL WL MTD	water cooler, wall mounted
WT EL	water elevation	WG	water gage
WHA	water hammer arrestor	WH	water heater
WJ	water jacket	WPD	water pressure drop
WPM	waterproof membrane	WEA	weather
WR	weather resistant	WSL	weather seal
WP	weather proof	WS	weather strip
WT	weight	WLD	welded
WWF	welded wire fabric	WWM	welded wire mesh
W	west	WO	where occurs
WF	wide flange	WL	wind load
WDW	window	WDMA	Window and Door Manufacturers Association
WU	window unit	WGL	wired glass
W/	with	W/O	without
WD	wood	WB	wood base
WBL	wood blocking		

Y

Abbreviation	Term	Abbreviation	Term
YD	yard	YR	year

GRAPHICAL SYMBOL SCHEDULE

Standard Callouts (actual size)

General Title
A-ANNO-TITL

4
AE555
WALL SECTION
SCALE: 1/2" = 1'-0"

Exterior Elevation Title
A-ANNO-TITL

4
AE555
ELEVATION
SCALE: 1/8" = 1'-0"

Floor Plan Title
A-ANNO-TITL

1
FLOOR PLAN
SCALE: 1/8" = 1'-0"
NORTH

General Grid
A-ANNO-GRID

Elevation Mark
A-ANNO-ELVT

FINISHED FLOOR
ELEV. ?

Door Callout
A-ANNO-DOOR

150

Window Callout
A-ANNO-WINDOW

EC

Room Designation
A-ANNO-ROOM

ROOM NUMBER
ROOM NAME

Record Document Stamp
A-ANNO-RCDC

This Record Document has been prepared based on information provided by others. The design Professional has not verified the accuracy and/or completeness of this information and shall not be responsible for any errors or omissions which may be incorporated herein as a result. Those relying on this Record Document are advised to obtain independent verification of its accuracy before applying it for any purpose

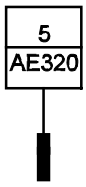
Date (ie April 25, 2002)

Standard Callouts (actual size)

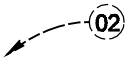
Keyed Note Text
A-ANNO-KEYN

01 KEYED NOTE TEXT
02 KEYED NOTE TEXT
03 KEYED NOTE TEXT
04 KEYED NOTE TEXT

Wall Type Callout
A-ANNO-WLTP

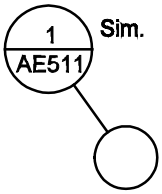


Keyed Note Leader
A-ANNO-KEYN

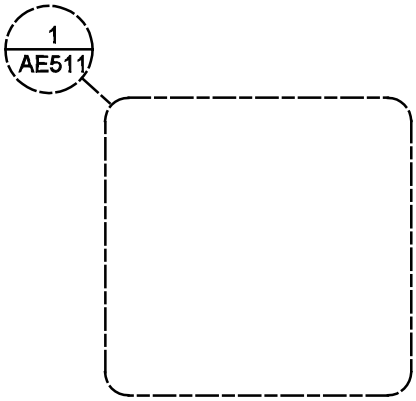


Section Callout
A-ANNO-SECT

Detail Callout
A-ANNO-DETL



Enlarged Plan Calout
A-ANNO-ENLG



Interior Elevation Callout
A-ANNO-ELEV

DOOR SCHEDULE

DOOR SCHEDULE

OPENING NO.	ROOM NAME	FIRE RATING	FRAME TYPE	DOOR TYPE	DOOR THICKNESS	DOOR HEIGHT	DOOR WIDTH	HARDWARE GRP.	THRESHOLD	REMARKS
	1st Floor									
101	Entry	90	15	B	1 3/4"	7'-0"	(2) 3'-0"	H20	8/AE512	Mullion, Card Reader/Panic
102	Entry		A	A	1 3/4"	7'-0"	(2) 3'-0"	H19	5/AE512	Removable Mullion Panic Card Reader, Auto Operator (Sargent Elec. Panic)
103	Entry		B	A	1 3/4"	7'-0"	(2) 3'-0"	H14	5/AE512	Removable Mullion, Panic, Card Reader
104	Men's		14	D	1 3/4"	7'-0"	3'-0"	H17	1/AE512	Privacy Lock
105	Women's		14	D	1 3/4"	7'-0"	3'-0"	H17	1/AE512	Privacy Lock
106	DHS		14	D	1 3/4"	7'-0"	3'-0"	H1	-	Key Pad, Panic

DOOR SCHEDULE

OPENING NO.	ROOM NAME	FIRE RATING	FRAME TYPE	DOOR TYPE	DOOR THICKNESS	DOOR HEIGHT	DOOR WIDTH	HARDWARE GRP.	THRESHOLD	REMARKS
	2nd Floor									
201	Training Room		14	D	1 3/4"	7'-0"	3'-0"	H2		Card Reader
203	Entry		14	D	1 3/4"	7'-0"	3'-0"	H4		Card Reader/Panic
204	Work Space		14	D	1 3/4"	7'-0"	3'-0"	H5		Key Lock
205	Break Area		4A	C	1 3/4"	7'-0"	3'-0"	H6		Passage
206	Conference		11	C	1 3/4"	7'-0"	3'-0"	H6		Passage
207	Work Room		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
218	Existing Mech. Room	Existing to Remain							3/AE512	
220	Existing Elec. Room	Existing to Remain							3/AE512	
221	Women's		13	D	1 3/4"	7'-0"	3'-0"	H11	1/AE512	Passage
222	Janitor Closet		13	D	1 3/4"	7'-0"	3'-0"	H12	1/AE512	Key Lock
223	Existing Mech. Room	Existing to Remain							3/AE512	
224	Men's		13	D	1 3/4"	7'-0"	3'-0"	H11	1/AE512	Passage
234	Existing Stair	Existing to Remain								Card Reader/Panic
250	Telephone		14	D	1 3/4"	7'-0"	3'-0"	H7		Key Lock
251	I.T.		4A	C	1 3/4"	7'-0"	3'-0"	H7		Key Lock
266	Unfinished		14	C	1 3/4"	7'-0"	3'-0"	H10	3/AE512	Key Lock
267	Unfinished		14	C	1 3/4"	7'-0"	3'-0"	H10	3/AE512	Key Lock
268	Unfinished II		14	C	1 3/4"	7'-0"	3'-0"	H10	3/AE512	Key Lock
269	Unfinished III		14	C	1 3/4"	7'-0"	3'-0"	H10	3/AE512	Key Lock
270	Unfinished		14	C	1 3/4"	7'-0"	3'-0"	H10	3/AE512	Key Lock
271	Work Space		13	E	1 3/4"	7'-0"	3'-0"	H4		Card Reader/Panic

DOOR SCHEDULE

OPENING NO.	ROOM NAME	FIRE RATING	FRAME TYPE	DOOR TYPE	DOOR THICKNESS	DOOR HEIGHT	DOOR WIDTH	HARDWARE GRP.	THRESHOLD	REMARKS
	2nd Floor Alternate									
202	Recpt./Waiting		1	C	1 3/4"	7'-0"	3'-0"	H3		Removable Mullion, Card Reader/Panic
208	Break Area		4A	C	1 3/4"	7'-0"	3'-0"	H8		Card Reader/Panic/Alarm
209	Break Area		14	C	1 3/4"	7'-0"	3'-0"	H9		Key Lock/Panic
210	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
211	Contact Analysis		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
212	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
213	Corridor		12	C	1 3/4"	7'-0"	3'-0"	H21		Card Reader/Panic/Alarm
214	Small Conference		13	C	1 3/4"	7'-0"	3'-0"	H18		Passage
215	Sec. Storage		14	D	1 3/4"	7'-0"	3'-0"	H7		Key Lock
216	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
217	Serv. Coord. II		10	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
219	Corridor		9	E	1 3/4"	7'-0"	3'-0"	H2		Card Reader
225	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H13		Key Lock
226	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H13		Key Lock
227	Executive Suite		6	E	1 3/4"	7'-0"	3'-0"	H2		Card Reader
228	Serv. Coord. II		13	E	1 3/4"	7'-0"	3'-0"	H10		Key Lock
229	Serv. Coord. II		13	E	1 3/4"	7'-0"	3'-0"	H10		Key Lock
230	Family Support		13	E	1 3/4"	7'-0"	3'-0"	H10		Key Lock
231	DHS Administration		13	E	1 3/4"	7'-0"	3'-0"	H10		Key Lock
232	Serv. Coord. II		13	E	1 3/4"	7'-0"	3'-0"	H10		Key Lock
233	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H13		Key Lock
235	Corridor		5	C	1 3/4"	7'-0"	3'-0"	H4		Card Reader/Panic
236	Services Lead		4A	C	1 3/4"	7'-0"	3'-0"	H13		Key Lock
237	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
238	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
239	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
240	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
241	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
242	Serv. Coord. II		13	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
243	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
244	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
245	Office Manager		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
246	Placement Spec.		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock

DOOR SCHEDULE

OPENING NO.	ROOM NAME	FIRE RATING	FRAME TYPE	DOOR				HARDWARE GRP.	THRESHOLD	REMARKS
				TYPE	THICKNESS	HEIGHT	WIDTH			
247	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
248	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
249	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
252	Behavior Spec.		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
253	Social Worker		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
254	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
255	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
256	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
257	Serv. Coord. II		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
258	Manager Support		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
259	Registered Nurse		4B	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
260	Serv. Coord. II		4A	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
261	Serv. Coord. II		3	C	1 3/4"	7'-0"	3'-0"	H10		Key Lock
262	Reception/Waiting		2	E	1 3/4"	7'-0"	3'-0"	H15		Card Reader/Panic
263	Lg. Conference		15	C	1 3/4"	7'-0"	(2) 3'-0"	H16		Passage/Panic

FINISH SCHEDULE

FINISH SCHEDULE KEY

WALLS (MATERIAL & FINISH)	
W1	Gypsum Board / Paint
W2	Cementitious Backer Board / 4'-0" High, 4" Ceramic Tile,
	Gypsum Board and Paint Above 4'-0"
W3	Aluminum Curtain Wall System
W4	Cementitious Backer Board / Full-Height, 4" Ceramic Tile
W5	Repair and Paint Existing Wall
W6	Existing Aluminum Window System
N/C	NO CHANGE

FLOOR	
F1	Carpet
F2	2" Ceramic Tile
F3	Sealed Concrete
N/C	NO CHANGE

CEILING	
C1	Gypsum Board
C2	24" x 48" Suspended Acoustical Panel Ceiling
C3	Open to Structure
N/C	NO CHANGE

BASE	
B1	4" Ceramic Tile
B2	Resilient Base
N/C	NO CHANGE

NOT USED	

MISC. NOTES	
A	Ceiling is 27'-0" above first floor or 12'-0" above second
	floor.
B	See AE110 and AE110A for ceiling height and location of
	ceiling divider designations.
C	Ceiling divider wall @ 9'-0" AFF - Refer to Detail
D	See Plan (AE110) for drop ceiling information
E	Paint new walls, existing walls no change
N/C	NO CHANGE

FINISH SCHEDULE

ROOM NAME	ROOM NAME	SHEET NO.	MISC. NOTES	FLOOR	WALLS								CEILING	
					NORTH		EAST		SOUTH		WEST		TYP	HT.
					MATERIAL	BASE	MATERIAL	BASE	MATERIAL	BASE	MATERIAL	BASE		
1st Floor - Base Bid														
101	Entry	AE101		F1	W3/W1	-/B2	W1	B2	W1/W3	-/B2	W1/EX	B2/EX	C2	12'-0"
102	Women's	AE101		F2	W2	B1	W4	B1	W2	B1	W1	B1	C1	8'-0"
103	Men's	AE101		F2	W2	B1	W4	B1	W2	B1	W1	B1	C1	8'-0"
104	Exist. Stair	AE101		F1	EX	EX	EX	EX	W5	B2	W5	B2	-	-
2nd Floor - Base Bid														
201	Entry	AE102		F1	W1	B2	W1	B2	W1	B2	W1	B2	C1	9'-6"
212	I.T.	AE102	D	F3	W1	B2	W1	B2	W1	B2	W1	B2	C2	NOTE D
212A	Telephone	AE102	D	F3	W1	B2	W1	B2	W1	B2	W1	B2	C2	NOTE D
237	Corridor	AE102	B	F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
240	Men's	AE102		F2	W4	B1	W2	B1	W2	B1	W2	B1	C1	9'-6"
241	Jan. Closet	AE102	B	F2	W1/W2	B1	W1/W2	B1	W1	B1	W1	B1	C3	-
242	Women's	AE102		F2	W2	B1	W2	B1	W4	B1	W2	B1	C1	9'-6"
243	Work Space	AE102	B, C	F1	W1/W6	-/B2	W1	B2	W1	B2	W1	B2	C2	VARIES
243A	Break Area	AE102		F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
243B	Work Room	AE102		F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
243C	Conference	AE102		F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	10'-0"
245	Corridor	AE102	B	F1	W1	B2	W1	B2	W5	B2	W1	B2	C2	9'-6"
248	Exist. Elec.	AE102		N/C	W5	-	W5	-	W5	-	W5	-	N/C	N/C
249	Exist. Mech Room	AE102		N/C	W5	-	W5	-	W5	-	W5	-	N/C	N/C
252	Exist. Stair	AE102		N/C	W5	-	W5	-	W5	-	W5	-	N/C	N/C
253	Training Room	AE102		F1	W1/W6	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
254	Exist. Stair	AE102		F1	N/C	-	-	-	W5	-	W5	-	-	-
258	Unfinished	AE102	E	N/C	W1	-	N/C	-	N/C/W1	-	W1	-	N/C	-
259	Unfinished II	AE102	E	N/C	W1	-	W1	-	W1	-	N/C	-	N/C	-
260	Unfinished III	AE102	E	N/C	W1	-	W1	-	N/C	-	N/C	-	N/C	-

FINISH SCHEDULE

ROOM NAME	ROOM NAME	SHEET NO.	MISC. NOTES	FLOOR	WALLS NORTH MATERIAL	WALLS NORTH BASE	WALLS EAST MATERIAL	WALLS EAST BASE	WALLS SOUTH MATERIAL	WALLS SOUTH BASE	WALLS WEST MATERIAL	WALLS WEST BASE	CEILING TYP	CEILING HT.
2nd Floor Alternate #1														
202	Recpt/Waiting			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
203	Lg. Conference		B	F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	VARIES
204	Break Area			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
205	Corridor		C, B	F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
208	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
209	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
210	Contact Anal			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
211	Reg Nurse			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
213	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
214	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
215	Services Lead			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
216	Placement Spec.			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
217	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
218	Behavior Spec.			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
219	Social Worker			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
220	Mngr Support			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
221	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
222	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
223	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
224	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
225	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
226	Serv. Super			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
227	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
228	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
229	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
230	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
231	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
232	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
233	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
234	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
235	Mail/Storage			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
235A	Printer/Fax			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
236	Office Mgr.			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
238	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
239	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
244	Sm. Conference			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	10'-0"
244A	Sec. Storage			F3	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
246	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
247	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
250	Exec. Suite			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-6"
250A	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
250B	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
250C	Family Support			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
250D	DHS Admin.			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
250E	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"
251	Serv. Coord. II			F1	W1	B2	W1	B2	W1	B2	W1	B2	C2	9'-0"

MECHANICAL SCHEDULES

LEGEND AND ABBREVIATIONS

LEGEND

SYMBOL OR ABBREVIATION	DEFINITION
	SOIL OR WASTE
	VENT
	COLD WATER
	HOT WATER
	HOT WATER RECIRCULATING
D	CONDENATE DRAIN LINE
I	WATER (LAWN IRRIGATION)
	BALL VALVE
	CALLIBRATED BALANCING VALVE

PIPING ABBREVIATIONS

SYMBOL	DESCRIPTION
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
CO	CLEANOUT
COTG	CLEANOUT TO GRADE
DIA	DIAMETER
FCO	FLOOR CLEANOUT
INV. ELEV.	INVERT ELEVATION
MECH	MECHANICAL
RD	ROOF DRAIN
SRD	SECONDARY ROOF DRAIN
TYP	TYPICAL
VTR	VENT THROUGH ROOF
WCO	WALL CLEANOUT

PLUMBING FIXTURE SCHEDULE

SYMBOL	FIXTURE	WASTE	VENT	C.W.	H.W.	MANUFACTURER & MODEL NO.	NOTES
WC 1	WALL MOUNTED WATER CLOSET	4"	2"	1"	--	AMERICAN STANDARD 2257.103 FLUSH VALVE - SLOAN ROYAL 111 ES-S	1.6 GPF FIXTURE CARRIER
WC 2	WALL MOUNTED WATER CLOSET	4"	2"	1"	--	AMERICAN STANDARD 2257.103 FLUSH VALVE - SLOAN ROYAL 111 ES-S	1.6 GPF FIXTURE CARRIER
U 1	URINAL	2"	2"	3/4"	--	AMERICAN STANDARD 6561-017 FLUSH VALVE - SLOAN ROYAL 186-1 ES-S	WALL MOUNTED, 1.0 GPF WALL CLEANOUT ABOVE URINAL
L 1	WALL MOUNTED LAVATORY	1 1/4"	1 1/4"	1/2"	1/2"	AMERICAN STD. 0355.012 FAUCET: ZURN OPTIMA ETF-600	WALL MOUNTED CONCEALED ARMS CARRIER
S 1	COUNTER TOP SINK	1 1/2"	2"	1/2"	1/2"	ELKAY LR-1716 FAUCET: CHICAGO 1100-GN2AE3-317CP	STAINLESS ST. - 1 COMPARTMENT
SS 1	FLOOR MOUNTED SERVICE SINK	3"	2"	1/2"	1/2"	AMERICAN STANDARD FLOORWELL 7741.000 FAUCET: CHICAGO 897	PROVIDE 48" VINYL HOSE
EWC 1	BI-LEVEL ELECTRIC WATER COOLER	2"	1 1/2"	1/2"	--	ELKAY EBFATL-8-SS 120V, 1PH	WALL HUNG STAINLESS STEEL CABINET
HB 1	HOSE BIBB	--	--	3/4"	--	CHICAGO 952	INTEGRAL VACUUM BREAKER
HB 2	WALL HYDRANT	--	--	3/4"	--	J.R. SMITH 5509QT	FREEZE-PROOF
FD 1	FLOOR DRAIN	SEE PLAN FOR SIZE		--	--	J.R. SMITH 2005 OR 2010 NICKEL BRONZE FINISH	USE SQUARE STRAINER HEADS IN TILE AREAS
RD 1	PRIMARY ROOF DRAIN	SEE PLAN FOR SIZE		--	--	J.R.SMITH 1010-ERC-CID	UNDERDECK CLAMP, SUMP RECEIVER - CAST IRON DOME
RD 2	SECONDARY ROOF DRAIN	SEE PLAN FOR SIZE		--	--	J.R.SMITH 1080-ERC-CID	UNDERDECK CLAMP, SUMP RECEIVER - CAST IRON DOME
DN 1	DOWNSPOUT	SEE PLAN FOR SIZE		--	--	J.R.SMITH 1770	PROVIDE BRONZE BIRDSCREEN

DENOTES FIXTURE FOR PEOPLE WITH DISABILITIES. PLUMBING CONTRACTOR TO MEET ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT (ADA) AND ANSI A117.1. CONSULT ARCHITECTURAL DRAWINGS FOR ELEVATIONS AND DIMENSIONS REGARDING MOUNTING HEIGHTS AND EXACT LOCATION OF FIXTURES.

BRANCH WATER LINE SCHEDULE

FIXTURE	FIXTURE UNITS	TOTAL QUANTITY OF FIXTURES SERVED BY A GIVEN PIPE SIZE					
		1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
WATER CLOSET	10	--	--	1	2	3	8
URINAL	5	--	1	2	--	--	--
LAVATORY	2	1	3	--	--	--	--
KITCHEN SINK	2	1	--	--	--	--	--
SERVICE SINK	4	--	1	--	--	--	--
DRINKING FOUNTAIN	1	2	--	--	--	--	--
TOTAL FIXTURE UNITS SERVED BY PIPE SIZE	--	3	11	25	52	117	318

NOTE:
MINIMUM PIPE SIZE TO ANY FIXTURE TO BE 1/2" WHERE PIPE SIZE IS SHOWN ON DRAWINGS, IT SHE BE FOLLOWED. IN THE EVENT PIPE SIZES ARE NOT SHOWN, THE SIZE OF ANY BRANCH LINE SHALL BE DETERMINED BY USING THIS TABLE. FIND SUM OF TOTAL FIXTURE UNITS ON BRANCH LINE, THEN REDUCE TOTAL BY SUBTRACTING OFF INDIVIDUAL FIXTURE UNITS FOR EACH.

DIFFUSER AND GRILLE SCHEDULES

DIFFUSER SCHEDULE

SYMBOL	TYPE	SIZE	LOCATION	AIR PATTERN	MAKE & MODEL
D-1 / CFM	SUPPLY AIR	6"Ø	CEILING	4-WAY	TITUS TDC-AA (1)(2)
D-2 / CFM	SUPPLY AIR	8"Ø	CEILING	4-WAY	TITUS TDC-AA (1)(2)
D-3 / CFM	SUPPLY AIR	10"Ø	CEILING	4-WAY	TITUS TDC-AA (1)(2)
D-4 / CFM	SUPPLY AIR	12"Ø	CEILING	4-WAY	TITUS TDC-AA (1)(2)
D-5 / CFM	SUPPLY AIR	6"Ø	CEILING	4-WAY	TITUS TDC-AA (1)(3)
D-6 / CFM	SUPPLY AIR	8"Ø	CEILING	4-WAY	TITUS TDC-AA (1)(3)
D-7 / CFM	SUPPLY AIR	10" Ø	CEILING	4-WAY	TITUS TDC-AA (1)(4)

NOTES:

(1) DIFFUSER SHALL HAVE OFF-WHITE FINISH.
(2) DIFFUSER SHALL BE LOUVERED TYPE, 24"x24" MODULE FOR T-BAR CEILING INSTALLATION.
(3) DIFFUSER SHALL BE LOUVERED TYPE FOR SURFACE MOUNTING.
(4) DIFFUSER LOUVERED FACE DIMENSION SHALL BE 15" x 15". CUT EXCESS FACE MATERIAL AWAY AS NECESSARY TO FIT IN CEILING GRID SPACE SHOWN.

3

3

REGISTER & GRILLE SCHEDULE

SYMBOL	SIZE	LOCATION	TYPE	MAKE & MODEL
SR-1 / CFM	10" x 6"	SIDEWALL	SUPPLY AIR	TITUS 301RL (1)
EG-1	22" x 22"	CEILING	RETURN AIR	TITUS PAR (2)(3)
SG-1	12" x 6"	CEILING	RETURN AIR	TITUS 355RL (2)(4)
SG-2	16" x 16"	CEILING	RETURN AIR	TITUS 355RL (2)(4)
SG-3	12" x 10"	SIDEWALL	RELIEF AIR	TITUS 355RL (2)(4)

NOTES:

(1) REGISTER SHALL BE COMPLETE WITH OFF-WHITE FINISH, OPPOSED BLADE DAMPER, AND ACCESSORIES FOR SURFACE MOUNTING.
(2) GRILLE SHALL HAVE OFF-WHITE FINISH.
(3) GRILLE SHALL BE PERFORATED TYPE FOR SURFACE MOUNTING.
(4) GRILLE SHALL BE LOUVERED TYPE FOR SURFACE MOUNTING.

EXHAUST AND HOOD SCHEDULES

EXHAUST FAN SCHEDULE

SYMBOL	TYPE	C.F.M	S.P.	R.P.M.	MOTOR	DRIVE	MAKE & MODEL	
EF-6	ROOF	150	.125"	520	1/6 H.P. 120/1/60	BELT	PENN DX06B	(1)

NOTES:

(1) EXHAUST FAN SHALL BE COMPLETE WITH COUNTERBALANCED BACKDRAFT DAMPER AND FACTORY ROOF CURB. (EF-1 THROUGH EF-5 EXISTING)

15-103a

3

ROOF HOOD SCHEDULE

SYMBOL	TYPE	MATERIAL	THROAT SIZE	HEIGHT	BLADE WIDTH	MAKE & MODEL
RH-1	RELIEF/COMB AIR	ALUMINUM	36" x 36"	36"	4"	PENN PENNHOUSE

NOTE:
0.081" ALUMINUM THICKNESS.

PUMPS AND EQUIPMENT SCHEDULES

PUMP SCHEDULE

SYMBOL	TYPE	SYSTEM	LOC.	G.P.M.	FT. OF HEAD	MOTOR	MAKE & MODEL
P-6	INLINE	HEATING HOT WATER	MECH RM	50.3	3.9	1/6 H.P. 120/1/60	BELL & GOSSETT BOOSTER PUMP 2"

NOTES:

(1) (P-1 THROUGH P-5 EXISTING)

15-107

MECHANICAL EQUIPMENT SCHEDULE

CH-2

CHILLER: AIR COOLED, ROTARY SCREW DUAL COMPRESSORS, VERTICAL DISCHARGE, 60 NOMINAL TONS. UNIT TO HAVE THE CAPACITY TO COOL 140 GPM OF 30 % GLYCOL SOLUTION FROM 55 DEG. F. TO 45 DEG. F. AT 95 DEG. F. AMBIENT AIR TEMP. UNIT TO HAVE LOW AMBIENT PERATION DOWN TO 0 DEG. F., CRANKCASE HEATERS, WEATHERPROOF CONTROL PANEL, FLOW SWITCH, 15 % MIN. LOAD SAFETY CUTOUTS, AND GAUGES. 141 MCA, 480 VOLT, 3 PHASE. UNIT MOUNTED STARTER. (CH-1 IS EXISITING).
MANUFACTURER: DUNHAM-BUSH
MODEL: ACDX-60

AH-2

AIR HANDLING UNIT: CUSTOM UNIT TO DELIVER 25,000 CFM AT 3.25" EXTERNAL STATIC PRESSURE. MIXED FLOW TYPE FAN, 30 HP, 480 VOLT, 3 PHASE MOTOR. HEATING COIL: 491,100 BTU/HR WITH 50.3 GPM AT 180 DEG. F. ENTERING WATER TEMPERATURE WITH 20 DEG. F. WATER TEMPERATURE DROP WITH 3.9 FT. WATER PRESSURE DROP. COOLING COIL: 673,100 BTU/HR WITH 142.2 GPM AT 45 DEG. F. ENTERING WATER TEMPERATURE WITH 10 DEG. F. WATER TEMPERATURE RISE WITH 13.4 FT. WATER PRESSURE DROP, 0.84" AIR PRESSURE DROP, 6 ROW CHILLED WATER COIL. COIL SECTIONS SHALL HAVE SINGLE SIDE PIPING CONNECTIONS WITH REMOVABLE ACCESS PANELS, FLAT FILTER SECTION WITH 2" DEEP REPLACEABLE FILTERS. UNIT TO BE COMPLETE WITH INTERNAL SPRING ISOLATORS, PARALLELL BLADE FRESH AND RETURN AIR DAMPERS SET FOR AIR STREAM IMPINGEMENT MIXING. CONDENSATE DRAIN CONNECTION, WATERTIGHT FLOOR AND GALVANIZED STEEL CABINET WITH 4" THICK ACOUSTICALLY INSULATED WALLS. SEE SPECIFICATIONS FOR NOISE LEVEL CRITERIA. UNIT NOT TO EXCEED 101" WIDE, 207" LONG, 88.5" HIGH (136.5" HGH WITH FACTORY PLENUM) OVERALL DIMENSIONS. 7,900 LBS. (AH-1 IS EXISTING).
MANUFACTURER: AIRE SYSTEMS MANUFACTURING CORP.

AC-2

AIR CONDITIONING UNIT: 18,000 BTU/HR, COOLING CAPACITY, INDOOR UNIT: WALL MOUNTED WITH FACTORY INSTALLED CONDENSATE HIGH LEVEL CUT-OFF, 208 VOLTS, 1 PHASE, MAXIMUM FUSE SIZE 15 AMPS, 0.70 MINIMUM CIRCUIT AMPACITY, 600 CFM. OUTDOOR UNIT: 208 VOLTS, 1 PHASE, MAXIMUM FUSE SIZE 20 AMPS, MINIMUM CIRCUIT AMPACITY 10.3, COMPRESSOR 7.4 R.L.A., LOW AMBIENT CONTROL, CRANKCASE HEATER, BUILT-IN CONTROL VOLTAGE TRANSFORMER, THERMOSTAT, AND CONTROL PANEL. (AC-1 IS EXISTING)
MANUFACTURER: EMI
INDOOR UNIT MODEL: WHP18D
OUTDOOR UNIT MODEL: SCC18D

FCU-1

FAN COIL UNIT: 1020 CFM, 0.40" ESP, HORIZONTAL, CONCEALED. HEATING COIL: 70,560 BTUH CAPACITY, 4.0 GPM @ 2.9 FT W.C. PRESSURE DROP, CAPACITY BASED ON 75°F ROOM AIR TEMPERATURE, 180°F ENTERING WATER TEMPERATURE AND 20°F WATER TEMPERATURE DROP. CHILLED WATER COIL: 20.4 MBH TOTAL COOLING CAPACITY, 4.1 GPM @ 3.9 FT. W.C. PRESSURE DROP, CAPACITY BASED ON 75°F ROOM AIR TEMP AND 10°F WATER TEMPERATURE DROP. 3-SPEED CABINET MOUNTED SWITCH,1590 RPM HIGH STATIC MOTOR, STEEL CABINET AND FILTER.
MANUFACTURER: AIR-THERM
MODEL: CP-A-101
ELECTRICAL: 545 WATTS

3

VAV BOX SCHEDULES

ELECTRICAL SCHEDULES

V.A.V. REHEAT BOX SCHEDULE

SYMBOL	DESIGN C.F.M.	MINIMUM C.F.M.	HEATING C.F.M.	N.C. AT 1.0" S.P.	A.P.D. W/COIL	BOX INLET	REHEAT COIL DATA								MAKE & MODEL
							MBH	EWT	EAT	LAT	GPM	WPD	ROWS	COIL SIZE	
VB-30															DELETED
VB-31															DELETED
VB-32															DELETED
VB-33	410	105	309	23	0.35"	7"	18.4	180	55	110	1.8	1.30"	2	11.5"x12"	TITUS AESV-300 (1)
VB-34	1070	230	642	32	0.59"	10"	38.3	180	55	110	3.8	2.10"	2	14"x14"	TITUS AESV-300
VB-35	1080	230	648	32	0.59"	10"	38.7	180	55	110	3.9	2.15"	2	14"x14"	TITUS AESV-300
VB-36	900	230	540	29	0.42"	10"	32.2	180	55	110	3.2	1.42"	2	14"x14"	TITUS AESV-300
VB-37	1230	325	738	26	0.37"	12"	44.0	180	55	110	4.4	3.29"	2	16.5"x16"	TITUS AESV-300
VB-38	665	145	399	24	0.52"	8"	23.8	180	55	110	2.4	2.05"	2	11.5"x12"	TITUS AESV-300
VB-39	780	175	468	27	0.37"	9"	27.9	180	55	110	2.8	1.42"	2	14"x14"	TITUS AESV-300
VB-40	480	105	288	23	0.35"	7"	17.2	180	55	110	1.7	1.30"	2	11.5"x12"	TITUS AESV-300
VB-41	200	80	231	26	0.41"	6"	13.8	180	55	110	1.4	0.60"	2	9.5"x12"	TITUS AESV-300 (1)
VB-42	550	105	330	24	0.46"	7"	19.7	180	55	110	2.0	1.33"	2	11.5"x12"	TITUS AESV-300 (1)
VB-43	200	80	174	23	0.23"	6"	10.4	180	55	110	1.0	0.24"	2	9.5"x12"	TITUS AESV-300 (1)
VB-44	375	80	189	24	0.26"	6"	11.3	180	55	110	1.1	0.35"	2	9.5"x12"	TITUS AESV-300
VB-45	440	145	399	28	0.52"	7"	23.8	180	55	110	2.4	2.10"	2	11.5"x12"	TITUS AESV-300 (1)
VB-46	430	105	258	22	0.22"	7"	15.4	180	55	110	1.5	0.83"	2	11.5"x12"	TITUS AESV-300 (1)
VB-47	430	105	258	22	0.22"	7"	15.4	180	55	110	1.5	0.83"	2	11.5"x12"	TITUS AESV-300 (1)
VB-48	430	105	258	22	0.22"	7"	15.4	180	55	110	1.5	0.83"	2	11.5"x12"	TITUS AESV-300 (1)
VB-49	430	105	258	22	0.22"	7"	15.4	180	55	110	1.5	0.83"	2	11.5"x12"	TITUS AESV-300 (1)
VB-50	390	80	234	27	0.41"	6"	14.0	180	55	110	1.4	0.60"	2	9.5"x12"	TITUS AESV-300 (1)
VB-51	275	80	165	23	0.23"	6"	9.8	180	55	110	1.0	0.24"	2	9.5"x12"	TITUS AESV-300 (1)
VB-52	410	105	246	22	0.22"	7"	14.7	180	55	110	1.5	0.83"	2	11.5"x12"	TITUS AESV-300 (1)
VB-53	400	80	240	27	0.21"	6"	14.3	180	55	110	1.4	0.60"	2	9.5"x12"	TITUS AESV-300 (1)
VB-54	460	300	300	22	0.25"	7"	17.9	180	55	110	1.8	1.30"	2	11.5"x12"	TITUS AESV-300 (1)
VB-55	280	80	168	23	0.23"	6"	10.0	180	55	110	1.0	0.24"	2	9.5"x12"	TITUS AESV-300 (1)
VB-56	1520	1470	1470	29	0.58"	12"	70.1	180	55	110	6.0	5.63"	2	16.5"x16"	TITUS AESV-300 (1)
VB-57	760	735	735	26	0.36"	9"	43.9	180	55	110	4.4	2.55"	2	14"x14"	TITUS AESV-300 (1)
VB-58	350	80	210	25	0.35"	6"	12.5	180	55	110	1.3	0.58"	2	9.5"x12"	TITUS AESV-300 (1)
VB-59	725	175	435	25	0.35"	9"	26.0	180	55	110	2.6	1.25"	2	14"x14"	TITUS AESV-300 (1)
VB-60	240	65	144	20	0.23"	5"	8.6	180	55	110	0.9	0.24"	2	9.5"x12"	TITUS AESV-300 (1)
VB-61	280	80	168	23	0.23"	6"	10.0	180	55	110	1.0	0.24"	2	14"x14"	TITUS AESV-300 (1)
VB-62	505	105	303	20	0.35"	7"	18.1	180	55	110	1.8	1.30"	2	9.5"x12"	TITUS AESV-300 (1)
VB-63	380	80	228	27	0.41"	6"	13.6	180	55	110	1.4	0.60"	2	9.5"x12"	TITUS AESV-300 (1)

NOTE:
HEATING CAPACITIES ARE BASED ON 180 DEG. F. ENT. WATER TEMPERATURE.
(VB-1 THROUGH VB-29 EXISTING).

(1) APPLY TO ALTERNATE #1 ONLY.

15-102bm

LIGHTING FIXTURE SCHEDULE

LIGHTING FIXTURE SCHEDULE

NOTE TO BIDDERS: COMPLY WITH SECTIONS 16511, 16521, AND 16570 OF THE SPECIFICATIONS.

REFER TO SPECIFICATIONS FOR IMPORTANT TECHNICAL REQUIREMENTS FOR LIGHTING FIXTURES, BALLASTS, AND LAMPS. THE CATALOG NUMBERS LISTED BELOW HAVE BEEN CAREFULLY PREPARED TO ASSIST BIDDERS IN SELECTING PRODUCTS TO ACHIEVE THE DESIGN CONCEPT, HOWEVER, PRIOR TO BIDDING, EACH MANUFACTURER SHALL COMPARE THE CATALOG NUMBERS SHOWN WITH THE DESCRIPTION AND REQUIREMENTS ON THE DRAWINGS, AND SHALL NOTIFY THE ARCHITECT/ENGINEER OF ANY DISCREPANCIES. SPECIFICALLY INCLUDED IN THIS EVALUATION SHALL BE THE VERIFYING OF PROPER MOUNTING KITS OR ACCESSORIES TO FACILITATE INSTALLATION AS SHOWN AT EACH LOCATION ON THE DRAWINGS. NO ALLOWANCE OR REDRESS WILL BE ALLOWED FOR DISCREPANCIES THAT WERE NOT REPORTED TO THE ARCHITECT/ENGINEER IN TIME FOR CORRECTION OR CLARIFICATION BEFORE THE BID. THE REPORTING OF ANY AMBIGUITY IS THE RESPONSIBILITY OF THE BIDDER. PROVIDE UNIT PRICES AND FIXTURE BRAND SELECTED FOR ADD/DELETE CHANGES FOR EACH FIXTURE TYPES SHOWN WITHIN 48 BUSINESS HOURS OF THE BID DATE. FAILURE TO COMPLY WITH THIS REQUIREMENT MAY DISQUALIFY THE PRODUCTS AND EMPOWER THE ENGINEER TO DETERMINE FAIR VALUE FOR FIXTURE AND INSTALLATION CHANGES, WITHOUT FURTHER INPUT FROM THE CONTRACTOR OR INSTALLER. SUBMITTAL PACKAGE SHALL INCLUDE LAMP MANUFACTURER AND CATALOG NUMBER ON EACH FIXTURE SHEET. ON ALL PENDANT MOUNTED FIXTURES, PROVIDE A SECOND SET OF PENDANTS, OF A DIFFERENT LENGTH, AS DIRECTED BY THE ARCHITECT/ENGINEER, PROVIDED AND INSTALLED AT NO ADDITIONAL CHARGE. ALL FIXTURES SHALL BE APPROVED BY UL OR ANOTHER ACCEPTABLE TESTING LAB FOR THE PURPOSE INTENDED AND WITH THE LAMP AND BALLAST PROPOSED. CONTRACTOR ALLOWANCE PRICES ARE ACCURATE WHEN THIS JOB WAS SPECIFIED, CONTRACTOR AND ELECTRICAL DISTRIBUTOR SHALL VERIFY THIS ALLOWANCE AND REPORT ANY PROBLEMS TO THE ENGINEER BEFORE THE BID. ALLOWANCE PRICE MAY OR MAY NOT INCLUDE LAMP(S) OR FREIGHT AS NOTED, AND DO NOT INCLUDE ANY TAXES. UNIVERSAL VOLTAGE (120/277) BALLASTS REQUIRED UNLESS NOTED OTHERWISE.

MARK	FIXTURE CHARACTERISTICS BODY / AIR / MOUNTING / DOOR LENS/LOUVER/REFLECTOR/OTHER	LAMP	WATTS	VOLTS	MANUFACTURER	CATALOG NUMBER	NOTES
CT	EXTRUDED ALUMINUM FIXTURES: LENGTHS AND CONFIGURATIONS SHOWN ON THE DRAWINGS; LAMPS FOUR FOOT WHERE POSSIBLE; PROGRAMMED START ELECTRONIC BALLASTS; T8 LAMPS; INTERNAL CONCEALED FASTENERS; CAST ELBOWS AND FITTINGS; COLOR AS NOTED AND/OR APPROVED BY ARCHITECT; ORIENT FIXTURE ACCORDING TO ARCHITECTS/ENGINEER'S INSTRUCTIONS. IF TRACK OR MONOPOINT FIXTURES INDICATED AS PART OF THE ASSEMBLY, SEE FIXTURE SCHEDULE FOR DETAILS. SWIVEL STEM MOUNT UNLESS NOTED OTHERWISE. INSTALL LEVEL AND STRAIGHT WITH INVISIBLE SPLICES. PROVIDE ALL REQUIRED HANGERS, SPLICERS, END CAPS, JOINTS, FEEDS, ETC., FOR A COMPLETE INSTALLATION.						
CT-02	8"X 3" OBROUND WITHOUT LENS; INDIRECT WITH PERFORATED BODY; PENDANT MOUNTED AT HEIGHT DIRECTED BY ARCHITECT.	2-F32T8 RE835	60W/4'	277/120V	PEERLESS	EN1-320900-MXX-XX-F-XXX-UNI-VOLT	
					LEDALITE	270-6-T02-L-N-X-1-UNIV P.S.-C PXX	
					LINEAR	N/A	
					LAM	CH82-2T8-O-PM-STXX-4-CBA-DT	
					NEORAY	N/A	
					GAMMALUX	GEH73U-232T8-XXXVERS-X-XX-OP-PTD-LH	
CT-02d	8"X 3" OBROUND WITHOUT LENS; INDIRECT WITH PERFORATED BODY; PENDANT MOUNTED AT HEIGHT DIRECTED BY ARCHITECT. APPROX 1% DIMMING BALLAST.	2-F32T8 RE835	60W/4'	277/120V	PEERLESS	EN1-320900-MXX-XX-F-XXX-UNI-VOLT-1% DIM	
					LEDALITE	270-6-T02-L-N-X-1-UNIV P.S.-C PXX-1% DIM	
					LINEAR	N/A	
					LAM	CH82-2T8-O-PM-STXX-4-CBA-DT-1% DIM	
					NEORAY	N/A	
					GAMMALUX	GEH73U-232T8-XXXVERS-X-XX-OP-PTD-LH-1% DIM	

MARK	FIXTURE CHARACTERISTICS BODY / AIR / MOUNTING / DOOR LENS/LOUVER/REFLECTOR/OTHER	LAMP	WATTS	VOLTS	MANUFACTURER	CATALOG NUMBER	NOTES
CT-02w	8"X 3" OBROUND WITHOUT LENS; INDIRECT WITH PERFORATED BODY; WALL MOUNTED AT HEIGHT DIRECTED BY ARCHITECT.	2-F32T8 RE835	60W/4'	277/120V	PEERLESS	EN1-320900-MXX-XX-F-XXX-UNI-VOLT-WALLMOUNT	
					LEDALITE	270-6-T02-L-N-X-1-UNIV P.S.-C PXX-WALL MOUNT	
					LINEAR	N/A	
					LAM	CH82-2T8-O-PM-STXX-4-CBA-DT-WALL MOUNT	
					NEORAY	N/A	
					GAMMALUX	GEH73U-232T8-XXXVERS-X-XX-OP-PTD-LH-WALL MOUNT	
DF	FLUORESCENT DOWNLIGHT; THERMALLY PROTECTED HOUSING: TO ACCOMMODATE MULTIPLE TRIMS AND REFLECTOR ASSEMBLIES FOR LAMPS AS LISTED BELOW; ELECTRONIC BALLASTS; LOW IRIDESCENT REFLECTOR FINISH (EVEN IF NOT SHOWN IN CATALOG #); SELF FLANGING TRIM UNLESS NOTED.						
DF-17	RECESSED DOWNLIGHT; VERTICAL, 6" APERTURE, 32W CF-AMALGAM LAMP, CLEAR.	1-CF-A32 RE835	50W	277/120V	PORTFOLIO	C6032E-6051LI	
					HUBBELL	D232-120/277-A6ARW	
					LIGHTOLIER	8021CCLW/6132BU	
					LITHONIA	AFV 32TRT 6AR MVOLT	
					OMEGA	OM6-32PLT-CS-120/277	
					PRESCOLITE	CFT632EB-STF602	
					KIRLIN	RR80601-97	
EDF-17	RECESSED DOWNLIGHT; VERTICAL, 6" APERTURE, 32W CF-AMALGAM LAMP, CLEAR. (EMERGENCY)	1-CF-A32 RE835	50W	277/120V	PORTFOLIO	C6032EEM-6051LI	
					HUBBELL	D232-120/277V-EM-A6ARW	
					LIGHTOLIER	8021CCLW/6132BU EM	
					LITHONIA	AFV 32TRT 6AR MVOLT EL	
					OMEGA	OM6-32PLT-CS-EM-120/277	
					PRESCOLITE	CFT632EBEM-STF602	
					KIRLIN	RR80601-97-73	
DL	LOW VOLTAGE DOWNLIGHTS, RECESSED, THERMALLY PROTECTED HOUSING, TO ACCOMMODATE MULTIPLE TRIMS AND REFLECTOR ASSEMBLIES FOR LOW VOLTAGE LAMPS AS LISTED BELOW, 4" APERTURE FOR MR16'S AND 6" NOMINAL FOR PAR36'S, MAX 7 1/2" DEEP.PROVIDE SAFETY GLASS LENS AS STANDARD, AND ACCESSORIES WHEN NOTED. PROVIDE EXZ LAMP (MR16) UNLESS INSTRUCTED OTHERWISE AT SUBMITTAL REVIEW. MAGNETIC DIMMABLE TRANSFORMERS, UNLESS NOTED OTHERWISE.						
DL-07	LOW VOLTAGE FIXED DOWNLIGHT, BLACK ALUMINUM REFLECTOR, MR16 LAMP, WHITE ALUMINUM TRIM, INTEGRAL 12V TRANSFORMER.	50W/MR16 12V	80W	277V	PRESCOLITE	LVH4-LV1B-277	
					HALO	H1499T-1421MB(277V)	
					MARCO	V100/68-482W	
					LIGHTOLIER	2000LV-2013BK-7997(277)	
					CAPRI	LV1EX/277-LC124	
					LITHONIA	LV3 277 3V01BZ	

MARK	FIXTURE CHARACTERISTICS BODY / AIR / MOUNTING / DOOR LENS/LOUVER/REFLECTOR/OTHER	LAMP	WATTS	VOLTS	MANUFACTURER	CATALOG NUMBER	NOTES
E	E PREFIX INDICATES THAT FIXTURE IS PROVIDED WITH AN EMERGENCY BATTERY PACK TO PROVIDE POWER TO ANY 2, 3, 4 OR 8 FOOT FLOURESCENT LAMP COMPATIBLE WITH ALL STANDARD AND ELECTRONIC BALLASTS; COMPLETELY SELF-CONTAINED TO PROVIDE 90 MINUTES OF EMERGENCY POWER TO FIXTURE BALLAST; MINIMUM LIGHT OUTPUT FOR TYPICAL 4' LAMP SHALL BE 1100 LUMENS OR HIGHER;UNIVERSAL TRANSFORMER FOR 120 OR 277 VOLTS; LOW VOLTAGE PROTECTION, COMBINATION TEST SWITCH AND AC "ON" INDICATOR; 10 YEAR PRO-RATA WARRANTY; INSTALL TEST SWITCH IN A MANNER THAT REQUIRES NO DISASSEMBLY FOR TESTING.						
E	EMERGENCY BATTERY PACK.		120/277`	3W	IOTA	I-80	
					BODINE	B50	
					LITHONIA	PS-1400	
					PRESCOLITE	EFPS-5	
					HUBBELL	E96	
					CHLORIDE	CFP841	
					LIGHTOLIER	FBP50	
E9	EXIT SIGN: METAL HOUSING; CEILING MOUNT, SEE DRAWINGS; ARROWS PER PLANS; LED LAMPS;EMERGENCY BATTERY PACK WITH 10 YEAR PRO-RATA WARRANTY; SELF-TESTING; EDGE LIGHTED CLEAR LENS; GREEN LETTERS ON CLEAR BACKGROUND. MUST MEET NFPA ILLUMINATION STANDARDS. UNITS SHOWN ARE CEILING MOUNT MODELS. CONTRACTOR TO PROVIDE MATCHING WALL MOUNTED UNITS WHERE REQUIRED.						
E9-01	SINGLE FACE:	LED	20W	120/277V	DUAL-LITE	LECSGWE	
					HUBBELL	X3EL-X-1-GW-X-NO	
					LITHONIA	LRP W 1 GC XX 120/277 ELN	
					ISOLITE	EDGL-EM-S-S-G-BK (BLACK HOUSING)	
					HIGH-LITES	LEDBPRXF0-2-GC-SX	
					CHLORIDE	STELX-X-1-SC-X	
					LIGHTOLIER	LEEC1GCX	
E9-02	DUAL FACE:	LED	20W	120/277V	DUAL-LITE	LECDGWE	
					HUBBELL	X3EL-X-2-GW-X-NO	
					LITHONIA	LRP W 2 GMR XX 120/277 ELN	
					ISOLITE	EDGL-EM-D-S-GM-BK (BLACK HOUSING)	
					HIGH-LITES	LEDBPRXFO-3-GW-SX	
					CHLORIDE	STELX-X-2-SC-X	
					LIGHTOLIER	LEEC2GC7	

MARK	FIXTURE CHARACTERISTICS BODY / AIR / MOUNTING / DOOR LENS/LOUVER/REFLECTOR/OTHER	LAMP	WATTS	VOLTS	MANUFACTURER	CATALOG NUMBER	NOTES
GS	TROFFERS: RECESSED FOR LAY-IN GRID; STATIC; HINGED AND LATCHED STEEL DOOR; .125 ACRYLIC PRISMATIC LENS, MINIMUN 1/8"; EARTHQUAKE CLIPS; MAX 5" DEEP; SPECIFICATION GRADE; PROGRAM START ELECTRONIC BALLASTS, T8 LAMPS; ONE BALLAST PER FIXTURE WHERE POSSIBLE, UNLESS TWO LEVEL SWITCHING IS SHOWN ON THE PLANS.						
GS-03	2X4, 2 LAMP.	2-F32T8 RE835	65W	277/120V	LITHONIA METALUX DAYBRITE HUBBELL LIGHTOLIER COLUMBIA	2 SP8G 232 A12125 MVOLT TUBRHP 2GP-232A125-UNV-EB81-PROGRAM START 2DG232-FS21-UNV-1/2EB-SPEC RS2GNA02UPSE XT2GVI232-UNV-SOP 4PS24-232G-FSA12.125-EB8-PROG	
IF	FLUORESCENT CEILING AND WALL FIXTURES; ALUMINUM HOUSING.						
IF-01	THERMOPLASTIC "GLASS" JAR CEILING BRACKET, BRUSHED ALUMINUM FINISH 13W MAX.	1-CF13	25W	120V	PRESCOLITE LURALINE MARCO TERON CLI SPERO LIGHTWAY	WB-13-2 (CF13Q) 33CX-13Q-OP-SA (CF13Q) BNF1-13S WE13-J CV-7WPG VX-2-13W-15-41-L VC13	
P3	PARABOLIC LOUVER FIXTURES WITH 3" LOUVERS IN PLASTIC PROTECTORS AND FULL DEPTH REFLECTOR; SIZE AS NOTED; PROGRAM START ELECTRONIC BALLASTS PER SPECS; T8 LAMPS; ONE BALLAST PER FIXTURE UNLESS NOTED FOR SWITCHING; AIR RETURN AND HEAT REMOVAL; EARTHQUAKE CLIPS INSTALLED ON GRID FIXTURES; HINGED AND LATCHED DOOR; LOW IRIDESCENT LOUVER FINISH, VERTICAL GRAIN DIE STAMPED LOUVERS; TWO FORMED BALLAST COVERS; MAX 1300 CD/M2 ABOVE 45 DEGREES.						
P3-02	2X2, 9 CELL LAY-IN; SEMI- SPECULAR SILVER LOUVERS.	2-F31T8U RE835	65W	277/120V	LITHONIA DAYBRITE METALUX COLUMBIA HUBBELL LIGHTOLIER	2PM3NGD-2U316-9LD-MVOLT-TUBRHP-2R 2P3GC231U6-33SL-UNV-1/2-EB-SPEC HR2EP3GAX-2U6S33I-UNV-PROGRAM START P422-231U1G-LD33-CD-EB8120/277 PROG RA2GCZACUPSE DPA2G9LS26U-U-SOP	
P3-02d	2X2, 9 CELL LAY-IN; SEMI-SPECULAR SILVER LOUVERS. APPROX. 1% DIMMING BALLASTS.	2-F31T8U RE835	65W	277/120V	LITHONIA DAYBRITE METALUX COLUMBIA HUBBELL LIGHTOLIER	2PM3NGD-2U316-9LD-MVOLT-TUBRHP-2R-1% DIM 2P3GC231U6-33SL-UNV-1/2-EB-SPEC-1% DIM HR2PE3GAX-2U6S33I-UNV-PROGRAM START-1% DIM P422-231U1G-LD33-CD-EB8120/277 PROG-1% DIM RA2GCZACUPSE-1% DIM DPA2G9LS26U-U-SOP-1% DIM	

MARK	FIXTURE CHARACTERISTICS BODY / AIR / MOUNTING / DOOR LENS/LOUVER/REFLECTOR/OTHER	LAMP	WATTS	VOLTS	MANUFACTURER	CATALOG NUMBER	NOTES
P3-04	2X4, 12 CELL LAY-IN; SEMI-SPECULAR SILVER.	2-F32T8 RE835	65W	277/120V	LITHONIA DAYBRITE METALUX COLUMBIA HUBBELL LIGHTOLIER	2PM3NGD-232-12LD-MVOLT-TUBRHP-2R 2P3GC232-26SL-UNV-1/2-EB-SPEC HR2EP3GAX-232S26I-UNV-PROGRAM START P4242-232G-LD26-CD-EB8120/277 PROG RD2GCZADUPSE DPA2G12LS232-U-SOP	
P3-06	2X4, 18 CELL LAY-IN; SEMI-SPECULAR SILVER, 3-LAMP.	3-F32T8 RE835	95W	277/120V	LITHONIA DAYBRITE METALUX COLUMBIA HUBBELL LIGHTOLIER	2PM3NGD-332-18LD-MVOLT-1/3TUBRHP-2R 2P3GC332-36SL-UNV-1/3-EB-SPEC HR2EP3GAX-332S36I-UNV-PROGRAM START-2BC P424-332G-LD36-CD-3EB8120/277 PROG RD3GCZAFUPSE DPA2G18LP332-U-03P	
SA	GENERAL PURPOSE INDUSTRIAL: WHITE ENAMEL, APERTURED REFLECTOR; PROGRAM START ELECTRONIC BALLASTS; T8 LAMPS; ONE BALLAST PER FIXTURE WHERE POSSIBLE; UNLESS TWO LEVEL SWITCHING IS SHOWN ON THE PLANS; STEM MOUNTED WITH TONG HANGERS.						
SA-01	4', 2-LAMP.	2-F32T8 RE835	65W	277/120V	LITHONIA LIGHTOLIER METALUX HUBBELL COLUMBIA DAYBRITE	EJA232-MVOLT-TUBRHP-THUN KWA232-U-SOP IA-232-UNV-PROGRAM START IG142R-PP10-UPS CSR4-232U-EB8120/277 PROG-CSTH IA232-UNV-1/2-EB-SPEC	
TX	SPECIAL FIXTURES AS INDICATED. MEET ALL REQUIREMENTS OF SPECIFICATIONS AND FIXTURE SCHEDULE. VISUAL AND FINISH APPROVAL REQUIRED.						
TX-01	EXTERIOR CANOPY WALL SCONCE (TO BE SELECTED BY ARCHITECT/ENGINEER)				CONTRACTOR ALLOWANCE: $500.00 EACH	(INCLUDING LAMPS & FREIGHT)	

PANEL SCHEDULE

ELECTRICAL PANEL "1LA" SCHEDULE (EX PANEL)

CLIENT: EFT **JOB:** DWS–DHS CONNECTION & 2ND FLOOR BUILD–OUT

VOLTS/PHASE/WIRE:	PANEL SIZE & TYPE:	MAIN SIZE & TYPE:	LOCATION:	CABINET:	NOTES:
120/208 V, 3 PH 4 WIRE	22" W x 6" D, BOLT–ON	225 AMPERE MAIN CB	ELECTRICAL ROOM 109	SQ–D – NQOD	

ACCESSORIES: PANEL DIRECTORY, IDENTIFICATION, GROUNDING BAR, INSULATED GROUND BAR, SUBFEED LUGS

WIRING:

CKT	OCP		OUTLETS			DESCRIPTION	LCL	PHASE LOAD			LCL	DESCRIPTION	OUTLETS			OCP		CKT
NO	AMP	POLE	LTG	CO	PWR		kVA	A	B	C	kVA		LTG	CO	PWR	AMP	POLE	NO
1	20	1			2	RM 111 FURNITURE	0.9	2.1			1.2	RM 113 OUTLETS		6		20	1	2
3	20	1			2	RM 111 FURNITURE	0.9		2.1		1.2	RM 113 OUTLETS		6		20	1	4
5	20	1			2	RM 111 FURNITURE	0.9			2.1	1.2	RM 113 OUTLETS		6		20	1	6
7	20	1			2	RM 111 FURNITURE	0.9	2.1			1.2	RM 113 OUTLETS		6		20	1	8
9	20	1			2	RM 111 FURNITURE	0.9		2.5		1.6	RM 134 OUTLETS		8		20	1	10
11	20	1			2	RM 111 FURNITURE	0.9			2.5	1.6	RM 134 OUTLETS		8		20	1	12
13	20	1			2	RM 111 FURNITURE	0.9	2.5			1.6	RM 134 OUTLETS		8		20	1	14
15	20	1			2	RM 111 FURNITURE	0.9		2.5		1.6	RM 134 OUTLETS		8		20	1	16
17	20	1			2	RM 111 FURNITURE	0.9			2.5	1.6	RM 115, 116, 117, 118 CO'S		8		20	1	18
19	20	1			2	RM 111 FURNITURE	0.9	2.5			1.6	RM 119 OUTLETS		8		20	1	20
21	20	1			2	RM 111 FURNITURE	0.9		2.1		1.2	RM 126 OUTLETS		6		20	1	22
23	20	1			2	RM 111 FURNITURE	0.9			2.1	1.2	RM 124, 125 OUTLETS		6		20	1	24
25	20	1			2	RM 111 FURNITURE	0.9	2.5			1.6	RM 120 OUTLETS		8		20	1	26
27	20	1			2	RM 111 FURNITURE	0.9		2.5		1.6	RM 120 OUTLETS		8		20	1	28
29	20	1			2	RM 111 FURNITURE	0.9			1.7	0.8	RM 120 OUTLETS		4		20	1	30
31	20	1			2	RM 119 FURNITURE	0.9	2.5			1.6	RM 120 OUTLETS		8		20	1	32
33	20	1			2	RM 119 FURNITURE	0.9		2.1		1.2	RM 120 OUTLETS		6		20	1	34
35	20	1			2	RM 119 FURNITURE	0.9			2.1	1.2	RM 120 OUTLETS		6		20	1	36
37	20	1			2	RM 119 FURNITURE	0.9	2.5			1.6	RM 120 OUTLETS		8		20	1	38
39	20	1			2	RM 119 FURNITURE	0.9		2.1		1.2	RM 120 OUTLETS		6		20	1	40
41	20	1			2	RM 119 FURNITURE	0.9			2.5	1.6	RM 120 OUTLETS		8		20	1	42
43	20	1			2	RM 119 FURNITURE	0.9	2.1			1.2	RM 125 OUTLETS		6		20	1	44
45	20	1			2	RM 119 FURNITURE	0.9		0.9			RM 108 COUNTER CO'S				20	1	46
47	20	1			2	RM 119, 128 FURNITURE	0.9			0.9		RM 108 COUNTER CO'S				20	1	48
49	20	1			2	RM 119, 128 FURNITURE	0.9	0.9				RM 108 RANGE				20	1	50
51	20	1			2	RM 119, 128 FURNITURE	0.9		0.9			RM 108 RANGE				20	1	52
53	20	1			2	RM 119, 128 FURNITURE	0.9			0.9		RANGE EXHAUST FAN				20	1	54
55	20	1				TIMECLOCK		0				UTILITY SHED				20	1	56
57	20	1				RM 111 FURNITURE			0			UTILITY SHED				20	1	58
59*	20	1		2		RESTROOM OUTLETS	0.4			0.4		STAIRWELL CO'S SOUTH				20	1	60
61*	20	1		2		DRINKING FOUNTAINS	0.4	0.4				SPARE				20	1	62
63*	20	1		4		~~CONNECTOR OUTLETS~~	~~0.8~~		0.8			SPARE				20	1	64
65	20	1				SPARE				0		SPARE				20	1	66
67	20	1				SPARE		0				SPARE				20	1	68
69*	20	1		1		~~CONNECTOR OUTLETS~~	~~0.4~~		0.4			SPARE				20	1	70
71*	20	1			1	AUTO DOOR OPENER	0.5			0.5		SPARE				20	1	72
73*	20	1			1	AUTO DOOR OPENER	0.5	0.5				SPARE				20	1	74
75*	20	1			1	FCU–1	0.235		0.235			SPARE				20	1	76
77	20	1				SPARE				0		SPARE				20	1	78
79	20	1				FIRE/SMOKE DAMPERS	0.5	1			0.5	ACCESS CONTROL PANEL			1	20	1	80*
81	20	1				SECURITY ALARM	0.5		1		0.5	ATC PANEL				20	1	82
83	20	1				FACP	0.5			1	0.5	EF–2				20	1	84
TOTALS:							KVA PER PHASE	21.6	20.135	19.2						TOTAL KVA		60.935
							AMPS PER PHASE	180	168	160						AVERAGE AMPS PER PHASE		169

3

NOTES: EXISTING PANELBOARD (SQUARE D). CONNECT NEW LOADS TO EXISTING SPARE CIRCUIT BREAKER. *=NEW LOAD.

ELECTRICAL PANEL "1MA" SCHEDULE (EX. PANEL)

CLIENT: EFT **JOB:** DWS-DHS CONNECTION & 2ND FLOOR BUILD-OUT

VOLTS/PHASE/WIRE:	PANEL SIZE & TYPE:	MAIN SIZE & TYPE:	LOCATION:	CABINET:	NOTES:
277/480 V, 3 PH 4 WIRE	22" W x 6" D, BOLT-ON	225 AMPERE MAIN CB	ELECTRICAL ROOM 109	SQ-D - NF	

ACCESSORIES: PANEL DIRECTORY, IDENTIFICATION, GROUNDING BAR, INSULATED GROUND BAR, SUBFEED LUGS

WIRING:

CKT	OCP		OUTLETS			DESCRIPTION	LCL	PHASE LOAD			LCL	DESCRIPTION	OUTLETS			OCP		CKT
NO	AMP	POLE	LTG	CO	PWR		kVA	A	B	C	kVA		LTG	CO	PWR	AMP	POLE	NO
1	-	-				-----	14.4	15.12			0.72	-----				-	-	2
3	90	3				AHU-1	14.4		15.12		0.72	P-1				20	3	4
5	-	-				-----	14.4			15.12	0.72	-----				-	-	6
7	-	-				-----	14.4	15.12			0.72	-----				-	-	8
9	90	3				AHU-2	14.4		15.12		0.72	P-2				20	3	10
11	-	-				-----	14.4			15.12	0.72	-----				-	-	12
13	-	-				-----	3	3.39			0.39	-----				-	-	14
15	20	3				RF-1	3		3.39		0.39	P-3				20	3	16
17	-	-				-----	3			3.39	0.39	-----				-	-	18
19	20	1				SPARE		0.39			0.39	-----				-	-	20
21	20	1				SPARE			0.39		0.39	P-4				20	3	22
23	20	1				SPARE				0.39	0.39	-----				-	-	24
25	20	1				SPARE		0				SPARE				20	1	26
27	20	1				SPARE			0			SPARE				20	1	28
29	20	1				SPARE				0		SPARE				20	1	30
31	20	1				SPARE		0				SPARE				20	1	32
33	20	1				SPARE			0			SPARE				20	1	34
35	20	1				SPARE				0		SPARE				20	1	36
37	20	1				SPARE		0				SPARE				20	1	38
39	20	1				SPARE			0			SPARE				20	1	40
41	20	1				SPARE				0		SPARE				20	1	42

TOTALS: KVA PER PHASE **34.02 34.02 34.02** TOTAL KVA **102.06**

AMPS PER PHASE **123 123 123** AVERAGE AMPS PER PHASE **123**

NOTES: EXISTING PANELBOARD (SQUARE D). CONNECT NEW LOADS TO EXISTING SPARE CIRCUIT BREAKER. *=NEW LOAD.

ELECTRICAL PANEL "2HA" SCHEDULE (EX PANEL)

CLIENT: EFT **JOB:** DWS–DHS CONNECTION & 2ND FLOOR BUILD–OUT

VOLTS/PHASE/WIRE:	PANEL SIZE & TYPE:	MAIN SIZE & TYPE:	LOCATION:	CABINET:	NOTES:
277/480 V, 3 PH 4 WIRE	22" W x 6" D, BOLT–ON	225 AMPERE MAIN CB	ELECTRICAL ROOM 210	SQ–D – NF	1,2,3

ACCESSORIES: PANEL DIRECTORY, IDENTIFICATION, GROUNDING BAR, INSULATED GROUND BAR, SUBFEED LUGS

WIRING:

CKT	OCP		OUTLETS			DESCRIPTION	LCL	PHASE LOAD			LCL	DESCRIPTION	OUTLETS			OCP		CKT
NO	AMP	POLE	LTG	CO	PWR		kVA	A	B	C	kVA		LTG	CO	PWR	AMP	POLE	NO
1	20	1	2			EXIT SIGNS	0.02	0.77			0.75	CORRIDOR DOWNLIGHTS	15			20	1	2*
3	20	1	3			RM 203,204	0.12		0.72		0.6	CORRIDOR 237 LTG	6			20	1	4*
5	20	1				SPARE				1	1	CONNECTOR VEST LRG	20			20	1	6*
7	20	1				SPARE		2			2	CONNECTOR ATRIUM PENDANTS	4			20	1	8*
9	20	1				SPARE			0			SPARE				20	1	10
11	20	1				SPARE				0		SPARE				20	1	12
13	20	1				SPARE		1.1			1.1	TRAINING/ENTRY AREA LTG	13			20	1	14*
15	20	1				SPARE			3.2		3.2	OPEN OFFICE 243	32			20	1	16*
17	20	1				SPARE				1.2	1.2	CONF/BREAK AREA LTG	12			20	1	18*
19	20	1				SPARE		1.82			1.82	SERV. COORD. OFFICE LTG	28			20	1	20*
21	20	1				SPARE			1.43		1.43	CONF. RM LTG	22			20	1	22*
23	20	1				SPARE				1.95	1.95	SUP/INDIV OFFICE LTG	30			20	1	24*
25	20	1				SPARE		1.4			1.4	CONF RM 244 AREA LTG	14			20	1	26*
27	20	1				SPARE			2.4		2.4	DHS SUITE LTG	24			20	1	28*
29	20	1				SPARE				0.65	0.65	RESTROOM LTG	10			20	1	30*
31	20	1				SPARE		0				SPARE				20	1	32
33	20	1				SPARE			0			SPARE				20	1	34
35	20	1				SPARE				0		SPARE				20	1	36
37	20	1				SPARE		0				SPARE				20	1	38
39	20	1				SPARE			1.1		1.1	EXIT/SIGNS/NIGHT LIGHT	22			20	1	40*
41	20	1				SPARE				1.3	1.3	EXIT/SIGNS/NIGHT LIGHT	25			20	1	42*

TOTALS:					
	KVA PER PHASE	7.09	8.85	6.1	TOTAL KVA 22.04
	AMPS PER PHASE	26	32	22	AVERAGE AMPS PER PHASE 27

NOTES: EXISTING PANELBOARD (SQUARE D). CONNECT NEW LOADS TO EXISTING SPARE CIRCUIT BREAKER. *=NEW LOAD.

ELECTRICAL PANEL "2LA" SCHEDULE (EX PANEL)

CLIENT: EFT

JOB: DWS-DHS CONNECTION & 2ND FLOOR BUILD-OUT

VOLTS/PHASE/WIRE:	PANEL SIZE & TYPE:	MAIN SIZE & TYPE:	LOCATION:	CABINET:	NOTES:
120/208 V, 3 PH 4 WIRE	22" W x 6" D, BOLT-ON	225 AMPERE MAIN CB	ELECTRICAL ROOM 203	SQ-D - NQOD	

ACCESSORIES: PANEL DIRECTORY, IDENTIFICATION, GROUNDING BAR, INSULATED GROUND BAR, SUBFEED LUGS

WIRING:

CKT	OCP		OUTLETS			DESCRIPTION	LCL	PHASE LOAD			LCL	DESCRIPTION	OUTLETS			OCP		CKT
NO	AMP	POLE	LTG	CO	PWR		kVA	A	B	C	kVA		LTG	CO	PWR	AMP	POLE	NO
1*	20	1			1	FURNITURE CONNECTION	0.9	1.3			0.4	TELEPHONE RM OUTLETS		2		20	1	2*
3*	20	1			1	FURNITURE CONNECTION	0.9		1.3		0.4	LAV TRANSFORMERS			2	20	1	4*
5*	20	1			1	FURNITURE CONNECTION	0.9			1.5	0.6	JAN CLOSET OUTLETS		3		20	1	6*
7*	20	1			1	FURNITURE CONNECTION	0.9	1.7			0.8	CORRIDOR OUTLETS		4		20	1	8*
9*	20	1			1	FURNITURE CONNECTION	0.9		1.7		0.8	CORRIDOR OUTLETS		4		20	1	10*
11*	20	1			1	FURNITURE CONNECTION	0.9			1.3	0.4	DRINKING FOUNTAIN OUTLETS		2		20	1	12*
13*	20	1			1	FURNITURE CONNECTION	0.9	2.1			1.2	IT OUTLETS		3		20	1	14*
15*	20	1			1	FURNITURE CONNECTION	0.9		1.7		0.8	IT OUTLETS		2		20	1	16*
17*	20	1			1	FURNITURE CONNECTION	0.9			2.1	1.2	IT OUTLETS		3		20	1	18*
19*	20	1			1	FURNITURE CONNECTION	0.9	1.3			0.4	TELEBOARD OUTLETS		1		20	1	20*
21*	20	1			1	FURNITURE CONNECTION	0.9		1.3		0.4	TELEBOARD OUTLETS		1		20	1	22*
23*	20	1			1	FURNITURE CONNECTION	0.9			1.7	0.8	TELEBOARD OUTLETS		2		20	1	24*
25*	20	1		4		WORKSPACE OUTLETS	0.8	0.8				SPARE				20	1	26
27*	20	1		3		WORKSPACE OUTLETS	0.6		0.6			SPARE				20	1	28
29*	20	1		3		WORKSPACE OUTLETS	0.6			0.6		SPARE				20	1	30
31*	20	1		1		BREAK AREA OUTLETS	0.2	0.4			0.2	LASER PRINTER				20	1	32*
33*	20	1		1		BREAK AREA OUTLETS	0.2		0.2			LASER PRINTER				20	1	34*
35*	20	1		1		REFRIGERATOR	0.2			0.2		LASER PRINTER				20	1	36*
37	20	1				SPARE		0				LASER PRINTER				20	1	38*
39	20	1				SPARE			0			(EF-1)				30	2	40*
41	20	1				SPARE				0		------				-	-	42*
43*	20	1		1		POKE THRU OUTLET	0.2	0.6			0.4	CONFERENCE OUTLETS		2		20	1	44*
45*	20	1		1		POKE THRU OUTLET	0.2		0.6		0.4	CONFERENCE OUTLETS		2		20	1	46*
47*	20	1		1		POKE THRU OUTLET	0.2			0.6	0.4	CONFERENCE OUTLETS		2		20	1	48*
49*	20	1		2		TRAINING RM OUTLETS	0.4	0.6			0.2	POKE THRU OUTLET		1		20	1	50*
51*	20	1		2		TRAINING RM OUTLETS	0.4		0.6		0.2	POKE THRU OUTLET		1		20	1	52*
53*	20	1		2		TRAINING RM OUTLETS	0.4			0.6	0.2	POKE THRU OUTLET		1		20	1	54*
55*	20	1			1	SCREEN	0.5	0.9			0.4	STORAGE OUTLETS		2		20	1	56*
57*	20	1			1	SCREEN	0.5		0.9		0.4	STORAGE OUTLETS		2		20	1	58*
59	20	1				SPARE				0		SPARE				20	1	60
61	20	1				SPARE		0				SPARE				20	1	62
63	20	1				B-2			0.5		0.5	EF-3				20	1	64
65	20	1				SPARE				0		SPARE				20	1	66
67	20	1				SPARE		2.25			2.25	WH-1				30	2	68
69	20	1				SPARE			2.25		2.25	WH-1				-	-	70
71	20	1				SPARE				0		SPARE				20	1	72
73*	20	1				EF-6	0.5	1.7			1.2	UH-1				20	1	74
75	20	1				CPD-1			1.2		1.2	UH-1				20	1	76
77	20	1				SPARE				1	1	SF-1				20	1	78
79	20	1				2ND FLOOR DAMPER		1			1	UH-2				20	1	80
81	20	1				SPARE			1		1	EF-4				20	1	82
83	20	1		1		EXTERIOR ROOF OUTLETS	0.2			0.7	0.5	BOILER B-1				20	1	84
TOTALS:							KVA PER PHASE	14.65	13.85	10.3							TOTAL KVA	38.8
							AMPS PER PHASE	122	115	86							AVERAGE AMPS PER PHASE	108

NOTES: EXISTING PANELBOARD (SQUARE D). CONNECT NEW LOADS TO EXISTING SPARE CIRCUIT BREAKER. *=NEW LOAD.
RELOCATE 30/2 CB IN POSITIONS 2,4 TO 40,42.

3

ELECTRICAL PANEL "2LB" SCHEDULE (EX PANEL)

CLIENT: EFT **JOB:** DWS–DHS CONNECTION & 2ND FLOOR BUILD–OUT

VOLTS/PHASE/WIRE:	PANEL SIZE & TYPE:	MAIN SIZE & TYPE:	LOCATION:	CABINET:	NOTES:
120/208 V, 3 PH 4 WIRE	22" W x 6" D, BOLT–ON	225 AMPERE MAIN CB	ELECTRICAL ROOM 203	SQ–D – NQOD	

ACCESSORIES: PANEL DIRECTORY, IDENTIFICATION, GROUNDING BAR, INSULATED GROUND BAR, SUBFEED LUGS

WIRING:

CKT	OCP		OUTLETS			DESCRIPTION	LCL	PHASE LOAD			LCL	DESCRIPTION	OUTLETS			OCP		CKT
NO	AMP	POLE	LTG	CO	PWR		kVA	A	B	C	kVA		LTG	CO	PWR	AMP	POLE	NO
1	–	–			–	-----		1			1	RM 203,204 OUTLETS		5		20	1	2
3	20	3			1	SPARE			0.2		0.2	POKE THRU OUTLETS		1		20	1	4*
5	–	–			–	-----				1.6	1.6	SERV COORD OUTLETS		4		20	1	6*
7	20	1		1		LAN RACK	0.2	0.8			0.6	SM CONF OUTLETS		3		20	1	8*
9	20	1		1		LAN RACK	0.2		0.8		0.6	SM CONF OUTLETS		3		20	1	10*
11	20	1		1		LAN RACK	0.2			0.8	0.6	SERV COORD OUTLETS		3		20	1	12*
13	20	1		1		LAN RACK	0.2	1.8			1.6	SERV COORD OUTLETS		4		20	1	14*
15	20	1				SPARE			1.6		1.6	SERV COORD OUTLETS		4		20	1	16*
17	20	1				SPARE				1.6	1.6	SERV COORD OUTLETS		4		20	1	18*
19	20	1				SPARE		0.8			0.8	EXEC SUITE OUTLETS		4		20	1	20*
21	20	1				SPARE			0.6		0.6	FAMILY SUPPORT OUTLETS		3		20	1	22*
23	20	1				SPARE				0.8	0.8	EXEC SUITE OUTLETS		4		20	1	24*
25	20	1				SPARE		0.8			0.8	SERV COORD OUTLETS		2		20	1	26*
27	20	2				AC–1 (OUTDOOR)			1.6		1.6	SERV COORD OUTLETS		4		20	1	28*
29	–	–				AC–1 (OUTDOOR)				1.6	1.6	SERV COORD OUTLETS		4		20	1	30*
31	20	1				SPARE		1			1	MAIL/STORAGE OUTLETS		5		20	1	32*
33	20	1		1		ATC PANEL	0.5		1.5		1	CORRIDOR OUTLETS		5		20	1	34*
35	20	1			1	ATC XFMR J–BOX	0.5			1.7	1.2	CORRIDOR OUTLETS		6		20	1	36*
37	20	1			1	ATC XFMR J–BOX	0.5	0.5				SPARE				20	1	38
39	20	1			1	ATC XFMR J–BOX	0.5		0.5			SPARE				20	1	40
41	20	1			1	ATC XFMR J–BOX	0.5			0.5		SPARE				20	1	42
TOTALS:							KVA PER PHASE	17.7	16.6	20.3							TOTAL KVA	54.6
							AMPS PER PHASE	148	138	169							AVERAGE AMPS PER PHASE	152

NOTES: EXISTING PANELBOARD (SQUARE D). CONNECT NEW LOADS TO EXISTING SPARE CIRCUIT BREAKER. *=NEW LOAD.

ELECTRICAL PANEL "2LB-1" SCHEDULE (NEW PANEL)

CLIENT: EFT

JOB: DWS-DHS CONNECTION & 2ND FLOOR BUILD-OUT

VOLTS/PHASE/WIRE:	PANEL SIZE & TYPE:	MAIN SIZE & TYPE:	LOCATION:	CABINET:	NOTES:
120/208 V, 3 PH 4 WIRE	22" W x 6" D, BOLT-ON	225 AMPERE MAIN CB	ELECTRICAL ROOM 203	SQ-D - NQOD	22,000 AIC

ACCESSORIES: PANEL DIRECTORY, IDENTIFICATION, GROUNDING BAR, INSULATED GROUND BAR

WIRING:

CKT	OCP		OUTLETS			DESCRIPTION	LCL	PHASE LOAD			LCL	DESCRIPTION	OUTLETS			OCP		CKT
NO	AMP	POLE	LTG	CO	PWR		kVA	A	B	C	kVA		LTG	CO	PWR	AMP	POLE	NO
1	20	1		4		SERV COORD OUTLETS	1.6	2.4			0.8	RECPT/WAITING OUTLETS		2		20	1	2
3	20	1		4		SERV COORD OUTLETS	1.6		2		0.4	RECPT/WAITING OUTLETS		1		20	1	4
5	20	1		4		SERV COORD OUTLETS	1.6			2	0.4	RECPT/WAITING OUTLETS		2		20	1	6
7	20	1		4		SERV COORD OUTLETS	1.6	2.2			0.6	RECPT/WAITING OUTLETS		3		20	1	8
9	20	1		4		SERV COORD OUTLETS	1.6		2.2		0.6	LG CONF OUTLETS		3		20	1	10
11	20	1		4		SERV COORD OUTLETS	1.6			2.1	0.5	SCREEN			1	20	1	12
13	20	1		4		SERV COORD OUTLETS	1.6	2			0.4	LG CONF OUTLETS		2		20	1	14
15	20	1				SPARE			0.6		0.6	LG CONF OUTLETS		3		20	1	16
17	20	1				SPARE				0.8	0.8	LG CONF OUTLETS		4		20	1	18
19	20	1		5		SERV COORD OUTLETS	1	1.2			0.2	POKE THRU OUTLETS		1		20	1	20
21	20	1		4		SERV COORD OUTLETS	0.8		1		0.2	POKE THRU OUTLETS		1		20	1	22
23	20	1		5		SERV COORD OUTLETS	1			1.2	0.2	POKE THRU OUTLETS		1		20	1	24
25	20	1		2		PLACEMENT SPEC OUTLETS	0.8	1			0.2	BREAK AREA OUTLET		1		20	1	26
27	20	1		4		BEHAVIOR SPEC OUTLETS	1.6		1.8		0.2	BREAK AREA OUTLET		1		20	1	28
29	20	1		4		MMGR SUPPORT OUTLETS	1.6			1.8	0.2	BREAK AREA OUTLET		1		20	1	30
31	20	1		2		ACCT TECH OUTLETS	0.4	0.6			0.2	BREAK AREA OUTLET		1		20	1	32
33	20	1		6		MMGR SUPPORT OUTLETS	1.2		1.4		0.2	DISPOSAL		1		20	1	34
35	20	1		10		SERV COORD OUTLETS	2			2.2	0.2	REFRIGERATOR		1		20	1	36
37	20	1		2		REG NURSE OUTLETS	0.8	1.6			0.8	BREAK AREA OUTLET		4		20	1	38
39	20	1		2		SERV COORD OUTLETS	0.8		0.8			SPARE				20	1	40
41	20	1		4		SERV COORD OUTLETS	1.6			1.6		SPARE				20	1	42
TOTALS:							KVA PER PHASE	11	9.8	11.7							TOTAL KVA	32.5
							AMPS PER PHASE	92	82	98							AVERAGE AMPS PER PHASE	90

NOTES: NEW PANELBOARD. PROVIDE SQUARE-D NQOD PANEL TO MATCH EXISTING.

EQUIPMENT SCHEDULE

MECHANICAL EQUIPMENT SCHEDULE

MARK	ITEM DESCRIPTION	LOAD DATA							WIRE AND CONDUIT SIZE	OVERCURRENT PROTECTION			DISCONNECT		
		HP	kW	MCA	FLA	VOLT	PH	Hz		FURN BY	DEVICE	LOCATION	FURN BY	DEVICE	LOCATION
CH-1 CH-1	CHILLER, 60 TON			141		480	3	60	3#1/0 THWN 1#6 GRND, 2" C	E	150A 3P CB	MDP	E	200 3P	ADJ. TO EQUIP.
AH-1 AH-1	AIR HANDLER	30			40	480	3	60	3#3 THWN 1#8 GR, 11/4" C	E	90A 3P CB	PANEL 1MA	E	VFD	ADJ. TO EQUIP.
AC-2 AC-2	INDOOR AC UNIT			1.4		208	1	60	3#12 THWN 1 #12 GR, 3/4" C	E	20A 2P CB	PANEL 2LB	E	30 A 2P FRN-R-5	ADJ. TO EQUIP.
AC-2 AC-2	OUTDOOR AC UNIT			10.3		208	1	60	3#12 THWN 1 #12 GR, 3/4" C	E	20A 2P CB	PANEL 2LB	E	30 A 2P FRN-20	ADJ. TO EQUIP.
FCU-1 FCU-1	FAN COIL UNIT		.335			120	1	60	2 #12 THWN 1 #12 GR, 3/4" C	E	20A 1P CB	PANEL 1LA	E	30 A 1P FRN-5	ADJ. TO EQUIP.
EF-6 EF-6	BATHROOM EXHAUST FAN	1/4				120	1	60	1#12 THWN 1 #12 GR, 3/4" C	E	20A 1P CB	PANEL 2LA	E	30 A 1P FRN-7	ADJ. TO EQUIP.

STARTER DATA														NOTES	MARK
FURN BY	DEVICE	LOCATION	SIZE	SPEED	CTRL VOLT	SELECTOR SWITCH	PUSH BUTTON	PILOT LAMP	NORMALLY OPEN CONTACTS	NORMALLY CLOSED CONTACTS	PHASE FAILURE RELAY	SCHEMATIC REFERENCE	REMOTE CTRL		
Q															CH-1 CH-1
E	VFD	SEE PLANS												VFD DIV 16	AH-1 AH-1
Q															AC-2 AC-2
Q															AC-2 AC-2
Q															FCU-1 FCU-1
Q															EF-6 EF-6

EQUIPMENT SCHEDULE KEY

E	DIVISION 16
Q	FURNISHED WITH THE EQUIPMENT
*	COORDINATE WITH THE DIVISION 15 TEMPERATURE CONTROL INSTALLER
**	AUTOMATIC CONTROL WIRING BY DIVISION 15