

TECHNICAL SPECIFICATION BOOK

VOLUME 1 OF 1

PROJECT:

REMODELATION OF THE CARIBE PLAZA OFFICE BUILDING FOR 9-1-1 FACILITIES

URBANIZACIÓN MARIO DÁVILA CINTRÓN, BARRIO MONACILLOS, SECTOR EL CINCO RIO PIEDRAS CARRETERA
ESTATAL PR-8838, EXTENSIÓN DE LA AVENIDA PONCE DE LEÓN # 1547 PUERTO RICO

OWNER:

DEPARTAMENTO DE SEGURIDAD PÚBLICA- NEGOCIADO DE SISTEMA DE EMERGENCIAS 9-1-1

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GOBIERNO DE PUERTO RICO
DEPARTAMENTO DE SEGURIDAD PÚBLICA
Negociado de Sistema de Emergencias 9-1-1





PROYECTO: REMODELACION EDIFICIO 911 - CARIBE PLAZA NÚM. 1547
URBANIZACIÓN MARIO DÁVILA CINTRÓN, BARRIO MONACILLOS, SECTOR EL CINCO RIO PIEDRAS CARRETERA ESTATAL PR-8838, EXTENSIÓN DE LA AVENIDA PONCE DE LEÓN PUERTO RICO

			VOLUMEN 1 OF 1	
Section No.	Section Title	Page Qty.	Section Description	Total Pag. By Divisions
TOC	TABLE OF CONTENTS	1		1
DIVISION 1 - GENERAL REQUIREMENTS				78
10000	GENERAL CONDITIONS	2		
11000	SUMMARY			
		6		
12900	PAYMENT PROCEDURES	3	Summary of the Work, Work phases, products ordered in advance, Owner-furnished products, use of premises, and work restrictions.	
13100	PROJECT MANAGEMENT AND COORDINATION	6	Administrative requirements for payment.	
13200	CONSTRUCTION PROGRESS DOCUMENTATION	6	Administrative requirements for project meetings and coordination.	
13233	PHOTOGRAPHIC DOCUMENTATION	3	Contractor's Construction Schedule, Submittals Schedule, and reports.	
13300	SUBMITTAL PROCEDURES	8	Construction photographs and videotapes.	
14000	QUALITY REQUIREMENTS	6	Procedures for submitting Action, Informational, and Delegated-Design Submittals.	
14200	REFERENCES	10	Quality assurance and -control requirements and special inspections.	
			Common definitions and terms; and acronyms and trade names of associations, government agencies, and other entities referenced in MASTERSPEC.	
15000	TEMPORARY FACILITIES AND CONTROLS		Temporary utilities and facilities for support, security, and protection.	
16000	PRODUCT REQUIREMENTS			
		5	Administrative and procedural requirements for product selection and handling, warranties, and product substitutions.	
17300	EXECUTION	6	Field engineering, progress cleaning, and general requirements for product installation.	
17329	CUTTING AND PATCHING	3	Special procedures.	
17700	CLOSEOUT PROCEDURES	4	Administrative and procedural requirements for Contract closeout.	
17823	OPERATION AND MAINTENANCE DATA	5	Emergency, operation, and maintenance manuals for products and equipment.	
17839	PROJECT RECORD DOCUMENTS	3	Record Drawings, Specifications, and Product Data.	
17900	DEMONSTRATION AND TRAINING	2	Administrative and procedural requirements for instructing Owner's personnel.	
DIVISION 02 - EXISTING CONDITIONS				5
24119	SELECTIVE STRUCTURE DEMOLITION	5	Demolition and removal of selected portions of buildings and site elements.	
DIVISION 3 - CONCRETE				53
30130	STRENGTHENING OF CONCRETE WITH FRP REINFORCEMENT	13		
31000	CONCRETE FORMWORK	3		
32000	CONCRETE REINFORCEMENT	13		
33000	CAST-IN-PLACE CONCRETE	20		
35416	HYDRAULIC CEMENT UNDERLAYMENT	4		
DIVISION 4 - MASONRY				9
04100	MASONRY MORTAR	3	General applications, walls, partitions.	
04220	UNIT MASONRY	6	General applications, walls, partitions.	
DIVISION 5 - METALS				43
05100	STRUCTURAL STEEL FRAMING	5	Framing systems.	
05118	Furnishing Structural Steel	8		
05119	Erecting Structural Steel	7		
53100	STEEL DECKING	13	Roof, floor, and composite types.	
54000	COLD-FORMED METAL FRAMING	6	Load-bearing and exterior non-load-bearing wall studs; floor, ceiling, and roof joists; rafters and roof trusses.	
55213	PIPE AND TUBE RAILINGS	4	Railings fabricated from aluminum, stainless-steel, and steel pipe and tubing.	
DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES				5
64023	INTERIOR ARCHITECTURAL WOODWORK	5	Trim, cabinets, tops, paneling, stairs, and ornamental items.	
DIVISION 7 - THERMAL AND MOISTURE PROTECTION				22
70150.19	PREPARATION FOR RE-ROOFING	3	Preparation for low-slope reroofing - tear-off and re-cover situations.	
72413	POLYMER-BASED EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS	7	Composite flexible coating and inner layer of rigid, cellular thermal insulation.	
75260	MEMBRANE ROOFING	9	SBS-modified bituminous membrane roofing; roofing insulation.	
78413	PENETRATION FIRESTOPPING	3	Through-penetration firestop systems.	
DIVISION 08 - OPENINGS				26
81113	HOLLOW METAL DOORS AND FRAMES	8	Standard and custom hollow metal units.	
81416	FLUSH WOOD DOORS	2	Wood-veneer, hardboard, and plastic-laminate-faced units.	
84113	ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS	2	Storefront framing, entrance doors, and hardware; and framing for window walls, ribbon walls, and punched openings.	
87100	DOOR HARDWARE	8	For specifying door hardware by using a schedule that names products or indicates BHMA designations.	
08800	GLAZING	6	For specifying door hardware by using a schedule that includes nonproprietary product descriptions.	
DIVISION 9 - FINISHES				54
92216	NON-STRUCTURAL METAL FRAMING	4		
92613	GYPSUM VENEER PLASTERING	7	Applied on gypsum base panels, unit masonry, or monolithic concrete.	
92900	GYPSUM BOARD	4	Interior and exterior gypsum board and tile backing panels.	
93100	TILING	9	Ceramic mosaic, quarry, paver, and wall tile.	
95113	ACOUSTICAL PANEL CEILINGS	5	Mineral-base and glass-fiber-base panels with exposed suspension systems.	
09653	RESILIENT BASE AND ACCESSORIES	4	Resilient base, stair accessories, and molding accessories.	
96813	TILE CARPETING	3	Modular carpet tile for commercial applications.	
98413	FIXED SOUND-ABSORPTIVE PANELS	3	Spline- and back-mounted units.	
99113	EXTERIOR PAINTING	9	Exterior painting.	
99123	INTERIOR PAINTING	6	Interior painting.	

DIVISION 10 - SPECIALTIES			0
	NOT USED	0	
DIVISION 11 - EQUIPMENT			0
	NOT USED	0	
DIVISION 12 - FURNISHINGS			0
	NOT USED	0	
DIVISION 13 - SPECIAL CONSTRUCTION			0
	NOT USED	0	
DIVISION 14 - CONVEYING EQUIPMENT			0
	NOT USED	0	
DIVISION 21 - FIRE SUPPRESSION			19
211313	WET-PIPE SPRINKLER SYSTEMS	19	Piping, specialties, valves, and sprinklers for wet-pipe sprinkler systems.
DIVISION 22 - PLUMBING			24
221116	DOMESTIC WATER PIPING	9	Potable-water distribution within the building.
221316	SANITARY WASTE AND VENT PIPING	8	Soil, waste, and vent piping within the building.
223300	ELECTRIC DOMESTIC WATER HEATERS	7	Household and commercial; tankless, instantaneous, and storage types.
DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING			52
230500	COMMON WORK RESULTS FOR HVAC	1	Common piping and equipment, materials, and installations.
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT	5	Single and multiple hangers, framing systems, and stands and supports.
230548	VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT	5	Vibration isolation devices and seismic restraints.
232300	REFRIGERANT PIPING	8	Piping, specialties, and refrigerant.
233113	METAL DUCTS	9	Rectangular and round, single- and double-wall ducts, including hangers and supports.
233423	HVAC POWER VENTILATORS	9	
233713	DIFFUSERS, REGISTERS, AND GRILLES	6	
236200	PACKAGED COMPRESSOR AND CONDENSER UNITS	5	
238223	UNIT VENTILATORS	4	Hot water, steam, and electric heating; chilled or DX cooling.
DIVISION 26 - ELECTRICAL			18
260500	COMMON WORK RESULTS FOR ELECTRICAL	2	Materials and methods common to multiple electrical systems.
260923	LIGHTING CONTROL DEVICES	2	Time switches, photoelectric relays, occupancy sensors, and multipole lighting controls.
261000	Medium-Voltage Electrical Distribution	2	
262000	Low-Voltage Electrical Distribution	2	
263000	Facility Electrical Power Generating and Storing Equipment	4	
263200	Packaged Generator Assemblies	2	Diesel- and gas-engine-driven types.
265100	INTERIOR LIGHTING	2	Normal and emergency lighting.
265600	EXTERIOR LIGHTING	2	Exterior luminaires including poles and standards.
DIVISION 27 - COMMUNICATIONS			6
272126	Voice Communications		
274100	Audio-Video Systems	2	
275116	PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS	2	Equipment, cabling, and raceways.
275119	SOUND MASKING SYSTEMS	2	Equipment and accessories for acoustical privacy.
DIVISION 28 - ELECTRONIC SAFETY AND SECURITY			4
281353	Intrusion Detection	2	
283100	Fire Detection And Alarm	2	
DIVISION 31 - EARTHWORK			0
	NOT USED	0	
DIVISION 32 - EXTERIOR IMPROVEMENTS			0
	NOT USED	0	
DIVISION 33 - UTILITIES			4
335000	Fuel Distribution Utilities	2	
337000	Electrical Utilities	2	
SUB TOTAL PAGES VOLUMEN 1 OF 1			422
HERE BY I CERTIFY THAT THIS DOCUMENT ARE INCLUDING		422	PAGES OF THECNICAL INFORMATION FOR THIS PROJECT.
			422

SECTION 01000 GENERAL CONDITIONS.

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.
- B. THE CONTRACTOR SHALL PROVIDE ALL CONTRACT FORMS.
 - 1. Owner Contractor Agreement: AIA A101-1997, Stipulated Sum.
 - 2. General Conditions OF THE CONTRACT FOR CONSTRUCTION: AIA A201-1997 (or the most recent revision), for Construction.

1.2 BIDDERS INSTRUCTIONS

- A. Bidders shall carefully read and comply with these specifications. The bidder, by making a bid, represents that he has read and understands the bidding documents and that his bid is made in accordance with them. Responsibility for failure to comply with these instructions shall not be waived because of bidders' ignorance of the same.
- B. All bidders shall tender a proposal strictly meeting these specifications. Alternates will be considered only after bidders have submitted main proposal meeting these specifications.
- C. Bidders shall carefully read and comply with *THE GENERAL REQUIREMENTS AND CONTRACT FORMS OF ASG*. The bidder, by making a bid, represents that he has read, understands and that his bid is made in accordance with them. Responsibility for failure to comply with these instructions shall not be waived because of bidders' ignorance of the same.

1.3 CODES LAWS AND REGULATIONS.

- A. All materials to be furnished and installed under these specifications shall meet or exceed the specification requirements.
- B. The Contractor shall comply fully with all applicable laws and regulations both federal and of the place of work.
- C. In case of conflict between applicable laws, codes and regulations, the matter shall be immediately referred to the Owner's Architect AND OR DESIGNATED INSPECTOR, who shall make, or cause to be made, an interpretation as which law, code or regulation is determining.
- D. The Contractor shall obtain all necessary permits or licenses to perform his work and pay the lawful fees therefor. He shall also obtain and pay for all necessary certificates of approval, which must be delivered to the Owner before final acceptance of the work.
- E. The validity and interpretations of this contract shall be governed by the laws of Puerto Rico.

1.4

MANUFACTURERS' NAMES.

- A. Whenever a trade name or the name of a certain manufacturer appears on the drawings or in the specifications, it is included to establish only a quality of construction and design. The absence of the "or equal" clause in an instance is not mean to exclude competition. Similar products of other manufacturers that are equal in quality, as decided by the Owner's architect, will be approved.

- B. The materials, equipment or parts mentioned by trade or manufacturer's name shall form the basis of the contract. If the Contractor wants to use another material, equipment or part instead of it, he shall request approval in writing. No such substitution shall be made without prior written approval of the Owner's engineer and no substitution will be considered after 30 days from the date of the award of the contract.
- C. All manufactured articles, materials, equipment and replacement's parts shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer instructions, unless herein specified otherwise.

1.6 WARRANTY.

- A. The Contractor shall guarantee labor and parts as provided under these specifications, AS PER ASG REQUIREMENTS, from the Date of Acceptance by Owner.

1.7 CONTRACTORS' INSURANCE.

- A. GENERAL REQUIREMENTS: REFERS TO THE ASG REQUIREMENTS.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01000

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Contract Documents.
 - 2. Type of the Contract.
 - 3. Work phases.
 - 4. Work under other contracts.
 - 5. Products ordered in advance.
 - 6. Owner-furnished products.
 - 7. Use of premises.
 - 8. Owner's occupancy requirements.
 - 9. Work restrictions.
 - 10. Specification formats and conventions.
- B. Related Sections include the following:
 - 1. Division 01 Section "Multiple Contract Summary" for division of responsibilities for the Work.
 - 2. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A.
 - 1. Project Identification: REMODELATION OF THE CARIBE PLAZA OFFICE BUILDING FOR 9-1-1 FACILITIES.
 - 2. Project Location: URBANIZACIÓN MARIO DÁVILA CINTRÓN, BARRIO MONACILLOS, SECTOR EL CINCO RIO PIEDRAS CARRETERA ESTATAL PR-8838, EXTENSIÓN DE LA AVENIDA PONCE DE LEÓN # 1547 PUERTO RICO.
- B. Owner: Departamento De Seguridad Pública - Negociado De Sistema De Emergencias 9-1-1
 - 1. Owner's Representative: Mr. Manuel González Azcuy - Comisionado Negociado de Sistemas de Emergencia 9-1-1.
- C. Project Coordinator: NOT ASSIGNED AT THIS MOMENT (appointed by Owner to serve as Project Coordinator).

D. The Work consists of the following **(but not limited to)**:

1. The Work includes:

a. Office Building.

- 1) Selective structure demolition: Demolition and removal of selected portions of buildings and elements.
- 2) Cutting and patching.
- 3) Maintenance of cast-in-place concrete. Concrete patching, repair, reinforcing, sealing, and crack injection.
- 4) Maintenance of masonry.
- 5) Unit masonry.
- 6) Portland cement plastering.
- 7) Hydraulic cement underlayment.
- 8) Cold-formed metal framing.
- 9) Pipe and tube railings.
- 10) Preparation for re-roofing. Preparation for low-slope reroofing - tear-off and re-cover situations.
- 11) Styrene-butadiene-styrene (sbs) modified bituminous membrane roofing.
- 12) Hollow metal doors and frames.
- 13) Aluminum-framed entrances and storefronts.
- 14) Glazing.
- 15) Overhead coiling doors.
- 16) Door hardware.
- 17) Non-structural metal framing.
- 18) Portland cement plastering.
- 19) Gypsum veneer plastering.
- 20) Gypsum board.
- 21) Acoustical panel ceilings.
- 22) Tile carpeting.
- 23) Ceramic tiles.
- 24) Fixed sound-absorptive panels.
- 25) Exterior-interior painting.
- 26) Common works for fire suppression piping & equipment, vibration and seismic controls.
- 27) Common works for plumbing.
- 28) Common works for hvac. Identification for hvac piping and equipment
- 29) Testing, adjusting, insulation and balancing for hvac.
- 30) Metal ducts. Diffusers, registers, and grilles.
- 31) Common works for electrical
- 32) Medium-voltage cables. Low-voltage electrical power conductors and cables.
- 33) Panelboards. Interior - exterior lighting.
- 34) Common works for communications & data.
- 35) Common works for electronic safety and security.
- 36) Zoned (dc loop) fire-alarm system.

b. Parking Building.

- 1) Cutting and patching. Demolition and removal of selected portions of buildings and elements. Concrete paving joint sealants.
- 2) Maintenance of cast-in-place concrete. Concrete patching, repair, reinforcing, sealing, and crack injection.
- 3) Maintenance of masonry.
- 4) Portland cement plastering.
- 5) Exterior - interior painting.
- 6) Common work for electrical.
- 7) Overhead coiling grilles.
- 8) Pipe and tube railings.

1.4 TYPE OF CONTRACT

- A. Project will be constructed under a single prime contract.

1.5 WORK PHASES/WORK SEQUENCE

- A. The Work shall be conducted in phases (BY BUILDING FLOOR'S) in the following order, with each phase substantially complete before beginning the next phase:
 - 1. **PHASE 1: FIFTH, SIXTH & GROUND FLOOR.** Interior works for office spaces as per construction documents. Exterior works, as per construction documents, for demolition and removal of existing upper & lower arches cast in place panels and the structural assessment report with the seismic rehabilitation of existing building.
CONCURRENT WORKS TO BE PERFORMED DURING THIS PHASE-1:
A- WORKS ON THE ROOF LEVEL. As per construction documents. Work of this phase shall be substantially complete **30** after the **Notice to Proceed** and to be completed before the **commence works of the sixth floor**.
B- SECOND FLOOR. Works as per construction document with all substantially prepared for use. Contractor shall coordinated with the owner, IT personnel, for the preparation of this space for the connectivity of the equipment of the floors as being substantially competed
C- REHABILITATION OF THE PARKING BLDG.: Parking bldg. Works as per construction documents and the structural assessment report for existing parking garage building per ASCE 41; seismic rehabilitation of existing buildings. Assessment Survey Condition Plans & Repair procedures and Products Technical Specifications.
 - 2. **PHASE 2: SECOND, THIRD & FOURTH FLOOR.** The remaining Work shall be substantially complete and ready for occupancy at time of Substantial Completion.
 - 3. **PHASE 3: NEW EXTERIOR GLAZING REMOVAL AND GENERAL SUBSTITUTION:** work sequence shall be fifth, sixth, second, third, fourth & ground floor.
 - 4. **Phase 4: ADDITIONAL EMERGENCY GENERATOR:** 1,000 kw, 480v, without fuel tank and with cabin in attenuated aluminum level 2- with ATS ASCO- 1,600 a, 480v, 3-ph, nema-4x. Concurrent work with all the above phases.

1.6 WORK UNDER OTHER CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Concurrent Work: Owner **will award** separate contract(s) for the following construction operations at Project site, **but not limited to**. Those operations will be conducted simultaneously with work under this Contract.
 - 1. A separate contract will be awarded to **DATA CABLING & EQUIPMENT** for works related to the Main Computers Servers and connecting cables each station drops.
 - 2. A separate contract will be awarded to **RADIO TELECOMMUNICATION** for provide, installing equipment antennas and connecting cables.
 - 3. A separate contract will be awarded to **FURNITURE & MODULAR PANELS SYSTEMS** for provide, installing equipment and accessories.
 - 4. A separate contract will be awarded to **ACCESS CONTROL & INTRUSION DETECTION SYSTEM** for provide, installing equipment and accessories.

1.7 PRODUCTS ORDERED IN ADVANCE

- A. General: Owner has negotiated Purchase Orders with suppliers of material and equipment to be incorporated into the Work. Owner will assign these Purchase Orders to Contractor. Costs for receiving, handling, storage if required, and installation of material and equipment are included in the Contract Sum.
 - 1. Contractor's responsibilities are same as if Contractor had negotiated Purchase Orders, including responsibility to renegotiate purchase and to execute final Purchase-Order agreements.
- B. List of Products Ordered in Advance:
 - 1. <Insert description, in separate subparagraphs, for each product ordered in advance.>

1.8 USE OF PREMISES

- A. General: Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of premises to indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy of Project site.
 - 2. Driveways and Entrances: Keep driveways, **parking garage, loading areas** and entrances serving premises clear and available to Owner, Owner's employees, 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.
- C. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.9 OWNER'S OCCUPANCY REQUIREMENTS

- A. Owner Occupancy of Completed Areas of Construction: 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. Contractor will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
 - 2. Contractor will 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 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's floor.

1.10 WORK RESTRICTIONS

- A. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours of 6:30 a.m. to 3:30 p.m., Monday through Friday, except otherwise indicated.
 1. Weekend Hours: Coordination and notify Construction Manager, Designated Inspector & Owner not less than two (2) days in advance.
 2. Early Morning Hours: Coordination and notify Construction Manager, Designated Inspector & Owner not less than two (2) days in advance.
 3. Hours for Utility Shutdowns: Coordination and notify Construction Manager, Designated Inspector & Owner not less than two (2) days in advance.
 4. Hours for **noisy activity**: Coordination and notify Construction Manager, Designated Inspector & Owner not less than two (2) days in advance.
- 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 **Construction Manager, Designated Inspector & Owner** not less than **two (2)** days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without **Construction Manager, Designated Inspector & Owner** written permission.
- C. Nonsmoking Building: Smoking is not permitted within the building or within **25 feet (8 m)** of entrances, operable windows, or outdoor air intakes.

1.11 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-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 because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- 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 011000

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 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 **Application for Payment forms with Continuation Sheets, Submittals Schedule and Contractor's Construction 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. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Submit draft of **AIA Document G703 Continuation Sheets**.
 - 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.
 - 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. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 - 8. 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.
9. 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.

1.3 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 Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Progress payments shall be submitted to Architect by the **<Insert day>** of the month. The period covered by each Application for Payment is one month, ending on the **[last day of the month] <Insert specific day of the month>**.
- D. Payment Application Forms: Use **AIA Document G702 and AIA Document G703 Continuation Sheets** as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- F. Transmittal: Submit **5** signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt **within 24 hours**. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

- H. 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 Construction Schedule (preliminary if not final).
 4. Schedule of unit prices.
 5. Submittals Schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
- I. 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.
- J. 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. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. 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.
 9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Project meetings.
 - 3. Requests for Interpretation (RFIs).
- B. See Division 01 Section "Multiple Contract Summary" for a description of the division of Work among separate contracts and responsibility for coordination activities not in this Section.
- C. See Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different 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.
 - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. 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.
 8. Startup and adjustment of systems.
 9. Project closeout activities.

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. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 2. Sheet Size: At least **8-1/2 by 11 inches** but no larger than **11 by 17 inches**.
 3. Number of Copies: Submit **five** opaque copies of each submittal.
 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, **within one week** of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; 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: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. LEED requirements.
 - l. Preparation of Record Documents.
 - m. Use of the premises **and existing building**.
 - n. Work restrictions.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Construction waste management and recycling.
 - r. Parking availability.
 - s. Office, work, and storage areas.
 - t. Equipment deliveries and priorities.
 - u. First aid.
 - v. Security.
 - w. Progress cleaning.
 - x. Working hours.
 3. Minutes: **Architect will record** and distribute meeting minutes.
- 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. The Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.

- j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 5. 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: Conduct progress meetings at **weekly** intervals at least. Coordinate dates of meetings with preparation of payment requests.
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: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. 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.
 - 1) Review schedule for next period.
 - 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) Status of correction of deficient items.
- 14) Field observations.
- 15) RFIs.
- 16) Status of proposal requests.
- 17) Pending changes.
- 18) Status of Change Orders.
- 19) Pending claims and disputes.
- 20) Documentation of information for payment requests.

3. Minutes: **Architect will record and distribute to Contractor** the meeting minutes.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - a. 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.

1.6 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

- C. Hard-Copy RFIs: **CSI Form 13.2A**.
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow **five** working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within **10** days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within **seven** days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log **weekly include the following**:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Submittals Schedule.
 - 3. Daily construction reports.
 - 4. Field condition reports.
- B. See Division 01 Section "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
- C. See Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
- D. See Division 01 Section "Photographic Documentation" for submitting construction photographs.

1.2 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: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- 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 connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. 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.**
- E. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

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

1.3 SUBMITTALS

- A. Submittals Schedule: Submit **five** 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.
- B. Preliminary Network Diagram: Submit **four** opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Submit **four** opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
 - 1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit **four** copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
- E. Daily Construction Reports: Submit **four** copies at **weekly** intervals.
- F. Field Condition Reports: Submit **four** copies at time of discovery of differing conditions.

1.4 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. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for **the Notice to Proceed** to date of **Final Completion**.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than **14** days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 21 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 - 4. Startup and Testing Time: Include not less than **five** days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work.
3. Other Constraints: **Furniture installation process.**

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary Network Diagram: Submit diagram within **7** days of date established for **the Notice to Proceed**. Outline significant construction activities for the first **30** days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than **14** days after date established for **the Notice to Proceed**.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 3. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

- a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Principal events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.

2.4 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. Equipment at Project site.
 - 3. Material deliveries.
 - 4. High and low temperatures and general weather conditions.
 - 5. Accidents.
 - 6. Stoppages, delays, shortages, and losses.
 - 7. Meter readings and similar recordings.
 - 8. Orders and requests of authorities having jurisdiction.
 - 9. Services connected and disconnected.
 - 10. Equipment or system tests and startups.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation **on CSI Form 13.2A**. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At **weekly** intervals, update schedule to reflect actual construction progress and activities. Issue schedule **one week** before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Submittals Schedule.
 - 3. Daily construction reports.
 - 4. Field condition reports.
- B. See Division 01 Section "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
- C. See Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
- D. See Division 01 Section "Photographic Documentation" for submitting construction photographs.

1.2 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: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- 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 connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. 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.**
- E. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

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

1.3 SUBMITTALS

- A. Submittals Schedule: Submit **five** 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.
- B. Preliminary Network Diagram: Submit **four** opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Submit **four** opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
 - 1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.
- D. CPM Reports: Concurrent with CPM schedule, submit **four** copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
- E. Daily Construction Reports: Submit **four** copies at **weekly** intervals.
- F. Field Condition Reports: Submit **four** copies at time of discovery of differing conditions.

1.4 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. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for **the Notice to Proceed** to date of **Final Completion**.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than **14** days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 21 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 - 4. Startup and Testing Time: Include not less than **five** days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Environmental control.

2. Work Stages: Indicate important stages of construction for each major portion of the Work.
 3. Other Constraints: **Furniture installation process.**
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion, **and the following interim milestones:**
1. Commencement of construction date: **May 30, 2011**
 2. Construction work at 25%, 50% and 75% of completeness.
 3. Substantial Completion date: **July 25, 2011**
 4. Punch List period.
 5. Final Completion: **Before August 1, 2011.**
- E. Contract Modification: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary Network Diagram: Submit diagram within **7** days of date established for **the Notice to Proceed**. Outline significant construction activities for the first **30** days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than **14** days after date established for **the Notice to Proceed**.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 3. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.

- b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing.
- 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
- 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
- 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Principal events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
- F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.

2.4 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. Equipment at Project site.

3. Material deliveries.
 4. High and low temperatures and general weather conditions.
 5. Accidents.
 6. Stoppages, delays, shortages, and losses.
 7. Meter readings and similar recordings.
 8. Orders and requests of authorities having jurisdiction.
 9. Services connected and disconnected.
 10. Equipment or system tests and startups.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation **on CSI Form 13.2A**. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At **weekly** intervals, update schedule to reflect actual construction progress and activities. Issue schedule **one week** before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
- B. See Division 01 Section "Closeout Procedures" for submitting **digital media** as Project Record Documents at Project closeout.
- C. See Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.

1.2 SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same label information as corresponding set of photographs.
- B. Construction Photographs: Submit **two** prints of each photographic view within **seven** days of taking photographs.
 - 1. Format: **8-by-10-inch (203-by-254-mm)** smooth-surface matte prints on single-weight commercial-grade photographic paper **enclosed back to back in clear plastic sleeves that are punched** for standard 3-ring binder.
 - 2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken if not date stamped by camera.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier.
 - 3. Digital Images: Submit a complete set of digital image electronic files **with each submittal of prints** on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.3 QUALITY ASSURANCE

- A. Photographer Qualifications: An individual who has been regularly engaged as a photographer of construction projects for not less than three years.

1.4 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.5 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 6.0 megapixels, and at an image resolution of not less than **1600 by 1200** pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified commercial photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Film Images:
 - 1. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
 - 2. Field Office Prints: Retain one set of prints of progress photographs in the field office at Project site, available at all times for reference. Identify photographs same as for those submitted to Architect.
- D. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1. Date and Time: Include date and time in filename for each image.
 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
- E. Preconstruction Photographs: Before **commencement of demolition**, take **digital** photographs of Project and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
1. Take **twelve** photographs to show existing conditions adjacent to property before starting the Work.
- F. Periodic Construction Photographs: Take **12 digital** photographs **weekly**, with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- G. Additional Photographs: Architect may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. See Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
- C. See Division 01 Section "Photographic Documentation" for submitting **construction photographs**.
- D. See Division 01 Section "Quality Requirements" for submitting test and inspection reports **and for mockup requirements**.
- E. See Division 01 Section "Closeout Procedures" for submitting warranties.
- F. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- G. See Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
- H. See Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.

1.2 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 responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. 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.

- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. 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. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow **7** days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow **7** days for review of each resubmittal.
- D. 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. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 - 1. Additional copies submitted for maintenance manuals will **not** be marked with action taken and will be returned.
- G. 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.

- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked **approval notation from Architect's action stamp**.
- I. 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.
- J. Use for Construction: Use only final submittals with mark indicating **approval notation from Architect's action stamp**.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- 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. Manufacturer's catalog cuts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Operational range diagrams.
 - h. Compliance with specified referenced standards.
 - i. Testing by recognized testing agency.
 - 4. Number of Copies: Submit **five** copies of Product Data, unless otherwise indicated. Mark up and retain one returned copy as a Project Record Document.
- 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: Fully illustrate requirements in the Contract Documents. 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. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 - k. Relationship to adjoining construction clearly indicated.
 - l. Seal and signature of professional engineer if specified.
 - m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
2. 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 **11 by 17 inches**.
 3. Number of Copies: Submit five opaque (bond) copies of each submittal.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit **three** full set(s) 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.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit **three** sets of Samples.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
1. Number of Copies: Submit **five** copies of product schedule or list, unless otherwise indicated.

- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. **Use CSI Form 1.5A.**
 - 1. Number of Copies: Submit **five** copies of subcontractor list, unless otherwise indicated. Architect will return **three** copies.

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 entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. 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.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. 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 in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. 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 in the Contract Documents.
- K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- L. 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.
- M. 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 in the Contract Documents.
- N. 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.
- O. 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 in the Contract Documents.
- P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Q. 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.
- R. 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.
- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Statement on condition of substrates and their acceptability for installation of product.
 - 2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

- T. 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.
- U. Construction **Photographs**: Comply with requirements specified in Division 01 Section "Photographic Documentation."
- V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
 - 1. Architect will not review submittals that include MSDSs and will return them for resubmittal.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

ACTION STAMP ON **SUBMITTALS**

1. ☐ **Approved**

Final Unrestricted Release: the Work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.

2. ☐ **Approved as Noted**

Final-but-Restricted Release: the Work covered by the submittal may proceed provided it complies both with Architect's notations and corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance.

3. ☐ **Not Approved, Revise and Resubmit**

Returned for Resubmittal: do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to Architect's notations and corrections.

4. ☐ **Not Approved, Resubmit**

Rejected: do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.

5. ☐ **Submit Additional Information**

Incomplete: do not proceed with the Work covered by the submittal. Prepare additional information requested, or required by the Contract Documents, that indicates compliance with requirements.

6. ☐ **Action Not Required**

Other Action: If the submittal is primarily for information purposes, record purposes, special processing, or other contractor activity.

Important Note:

The limited nature of the Architect's approval is also specifically indicated in the General Conditions. They state that the Architect's approval is "only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents." The General Conditions further state that the Architect's review "is not conducted for the purpose of determining the accuracy and completeness of other details, such as dimensions and quantities, or for substantiating instructions for installation or performance. . . ."

Remarks: _____

- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 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. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 02 through 49 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. **Approved mockups establish the standard by which the Work will be judged.**
- D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 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 trades people of the corresponding generic name.
- K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of **seven** previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. General: If 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.
- B. 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 requirements. Refer uncertainties to Architect for a decision before proceeding.

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. Record of temperature and weather 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. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. 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.
- C. 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, as well as sufficient production capacity to produce required units.
- D. 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.
- 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 products 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 regulations governing the Work.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

- H. 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.
- I. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect **seven** days in advance of dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Demolish and remove mockups when directed, unless otherwise indicated.
- J. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 49.

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 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, **and the Contract Sum will be adjusted by Change Order.**
- B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least **48** 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. 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 as specified in Division 01 Section "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not releases, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- F. 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. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -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.

1.7 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified **testing agency** to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.

2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, this includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

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. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
 2. Comply with the Contract Document requirements for Division 01 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 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 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 date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should 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 publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists (The)
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	ACI International (American Concrete Institute)
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute
AIA	American Institute of Architects (The)
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association

APA	APA - The Engineered Wood Association
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (The American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	AWCI International (Association of the Wall and Ceiling Industry International)
AWCMA	American Window Covering Manufacturers Association (Now WCSC)
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association

CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRRC	Cool Roof Rating Council
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet & Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association
FIBA	Federation Internationale de Basketball (The International Basketball Federation)
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FM Approvals	FM Approvals
FM Global	FM Global (Formerly: FMG - FM Global)
FMRC	Factory Mutual Research (Now FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council

GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Now GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.
IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IRST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association (Now part of CPA)
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association

MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFHS	National Federation of State High School Associations
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)

NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Now ITS)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association

SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc.
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association (Now WCSC)
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association)
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMPMA	Wood Moulding & Millwork Producers Association

WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

BOCA	BOCA International, Inc. (See ICC)
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials (See ICC)
ICBO ES	ICBO Evaluation Service, Inc. (See ICC-ES)
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.
SBCCI	Southern Building Code Congress International, Inc. (See ICC)
UBC	Uniform Building Code (See ICC)

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

CE	Army Corps of Engineers
CPSC	Consumer Product Safety Commission
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FDA	Food and Drug Administration
GSA	General Services Administration
HUD	Department of Housing and Urban Development
LBL	Lawrence Berkeley National Laboratory
NCHRP	National Cooperative Highway Research Program (See TRB)
NIST	National Institute of Standards and Technology

OSHA	Occupational Safety & Health Administration
PBS	Public Building Service (See GSA)
PHS	Office of Public Health and Science
RUS	Rural Utilities Service (See USDA)
SD	State Department
TRB	Transportation Research Board
USDA	Department of Agriculture
USPS	Postal Service

- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA)
CFR	Code of Federal Regulations
DOD	Department of Defense Military Specifications and Standards
DSCC	Defense Supply Center Columbus (See FS)
FED-STD	Federal Standard (See FS)
FS	Federal Specification
FTMS	Federal Test Method Standard (See FS)
MIL	(See MILSPEC)
MIL-STD	(See MILSPEC)
MILSPEC	Military Specification and Standards
UFAS	Uniform Federal Accessibility Standards

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. See Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
- C. See Divisions 02 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 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[, **except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise**]. 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. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.3 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**.
 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 **7** days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within **7** 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.
- B. Comparable Product 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. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within **7** days of receipt of request, or **7** > days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."

- b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
- C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.4 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.

1.5 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.
- B. Delivery and Handling:
 - 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.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Store cementitious products and materials on elevated platforms.
 - 5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 7. Protect stored products from damage and liquids from freezing.

1.6 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.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. 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.
- 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. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
 3. 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 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- 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. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 3. Where products are accompanied by the term "as selected," Architect will make selection.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
 3. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
 4. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product 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, density, 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, density, 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 **21** days after **the Notice of Award**. 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 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.

2.3 COMPARABLE PRODUCTS

- A. Conditions: Architect will consider Contractor's request for comparable product 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. 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)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.
- B. See Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

- A. Certified Surveys: Submit **two** copies signed by **land surveyor**.
- B. Final Property Survey: Submit [10] <Insert number> copies showing the Work performed and record survey data.

1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.

- B. 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, storm sewer, and 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.
- C. 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. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 4. 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** and **Owner** 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. 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.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. 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. **Submit requests on CSI Form 13.2A, "Request for Interpretation."**

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a **professional engineer** to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. 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 and piers from two or more locations.
- E. 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 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

3.5 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.
- 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. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. 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.
 - 3. Coordinate installation of anchorages. 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.
- H. 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.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

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 (27 deg C).
 - 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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. 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.
- H. 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.
- I. 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.
- J. 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 01 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 01 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 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 SUBMITTALS

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

1.3 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.
 - 1. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 2. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety.

- B. 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.

1.4 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 5. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
 2. Warranties.
 3. Final cleaning.

1.2 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.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

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

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 1. Submit a final Application for Payment according to Division 01 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.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit four copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.5 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. 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 (215-by-280-mm) 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.
- C. 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 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 antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or

- broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to 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 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.
 - r. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. 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 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Emergency manuals.
 - 2. Operation manuals for systems, subsystems, and equipment.
 - 3. Maintenance manuals for the care and maintenance of **products, materials, and finishes**.
- B. See Divisions 02 through 49 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 SUBMITTALS

- A. Manual: Submit **three copies** of each manual in final form at least **15** days before final inspection. Architect will return copy with comments within **15** days after final inspection.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit **3** copies of each corrected manual within **7** days of receipt of Architect's comments.

PART 2 - PRODUCTS

2.1 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain a title page, table of contents, and manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name, address, and telephone number of Contractor.
 - 6. Name and address of Architect.
 - 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for type of emergency, emergency instructions, and emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component for **fire flood gas leak water leak power failure equipment failure**
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include instructions on stopping, shutdown instructions for each type of emergency, operating instructions for conditions outside normal operating limits, and required sequences for electric or electronic systems.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and equipment descriptions, operating standards, operating procedures, operating logs, wiring and control diagrams, and license requirements.

- B. Descriptions: Include the following:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include start-up, break-in, and control procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; and required sequences for electric or electronic systems.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and inspection procedures, types of cleaning agents, methods of cleaning, schedule for cleaning and maintenance, and repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including maintenance instructions, drawings and diagrams for maintenance, nomenclature of parts and components, and recommended spare parts for each component part or piece of equipment:
- D. Maintenance Procedures: Include test and inspection instructions, troubleshooting guide, disassembly instructions, and adjusting instructions, **and demonstration and training videotape if available**, that detail essential maintenance procedures:
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component

incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
- B. See Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- C. See Divisions 02 through 49 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit **two** sets of marked-up Record Prints.
- B. Record Specifications: Submit **two copies** of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit **two copies** of each Product Data submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 1. Preparation: 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 would be difficult to identify or measure and record later.
 - b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record CAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Architect. When authorized, prepare a full set of corrected CAD Drawings of the Contract Drawings, as follows:
1. Format: **PDF**.
 2. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications 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. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. Note related Change Orders, **Record Product Data**, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

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 Specifications**, and Record Drawings where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. 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.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Demonstration and training videotapes.
- B. See Divisions 02 through 49 Sections Sections for specific requirements for demonstration and training for products in those Sections.

1.2 SUBMITTALS

- A. Instruction Program: Submit **two** copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Demonstration and Training Videotapes: Submit **two** copies within **seven** days of end of each training module.

1.3 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at **Project site**. Review methods and procedures related to demonstration and training.
- D. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

1. 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.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:
 1. Basis of System Design, Operational Requirements, and Criteria: Include system and equipment descriptions, operating standards, regulatory requirements, equipment function, operating characteristics, limiting conditions, and performance curves.
 2. Documentation: Review emergency, operations, and maintenance manuals; Project Record Documents; identification systems; warranties and bonds; and maintenance service agreements.
 3. Emergencies: Include instructions on stopping; shutdown instructions; operating instructions for conditions outside normal operating limits; instructions on meaning of warnings, trouble indications, and error messages; and required sequences for electric or electronic systems.
 4. Operations: Include startup, break-in, control, and safety procedures; stopping and normal shutdown instructions; routine, normal, seasonal, and weekend operating instructions; operating procedures for emergencies and equipment failure; and required sequences for electric or electronic systems.
 5. Adjustments: Include alignments and checking, noise, vibration, economy, and efficiency adjustments.
 6. Troubleshooting: Include diagnostic instructions and test and inspection procedures.
 7. Maintenance: Include inspection procedures, types of cleaning agents, methods of cleaning, procedures for preventive and routine maintenance, and instruction on use of special tools.
 8. Repairs: Include diagnosis, repair, and disassembly instructions; instructions for identifying parts; and review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner with at least **seven** days' advance notice.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a **written a demonstration** performance-based test.

END OF SECTION 017900

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. See Division 31 Section "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.2 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 Salvage: Detach items from existing construction and deliver them to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.
- B. Pre-demolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.
- C. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 - 1. Comply with submittal requirements in Division 01 Section "Construction Waste Management and Disposal."

1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Pre-demolition Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- 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. Owner will remove hazardous materials under a separate contract.
- E. Hazardous Materials: It is unknown whether 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. Owner will remove hazardous materials under a separate contract.
- F. Hazardous Materials: Hazardous materials are present in construction to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- G. Storage or sale of removed items or materials on-site is not permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs and preconstruction videotapes.
 - 1. Comply with requirements specified in Division 01 Section "Photographic Documentation."
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off indicated utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 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. 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.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. 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.
 - 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 5. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
 - 1. Clean and repair salvaged items to functional condition adequate for intended reuse. Paint items. Coordinated with Architect.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area on-site.
 - 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition, cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 1. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

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

END OF SECTION 024119

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

1. RELATED DOCUMENTS:

A. The general provision of the contract, including General and Special Conditions, apply to the work specified in this section.

2. DESCRIPTION OF WORK:

A. The extent of formwork is indicated by the concrete structures shown on the drawings. The work includes providing formwork and shoring for architectural and structural cast-in-place concrete, and the installation into formwork of anchor bolts, setting plates, bearing plates, anchorages, inserts frames, nosing and other items to be embedded in concrete (but not including reinforcing steel).

3. GENERAL:

A. Codes and Standards: Unless otherwise shown or specified, design, construct, erect, maintain and remove forms and related structures for cast-in-place concrete work in compliance with the American Concrete Institute standard ACI-347-14, "Recommended Practice for Concrete Formwork", ACI 301, ACI 318 and ACI 117.

B. Mock-up or Sample Panels: Provide formwork for mock-up or sample panels as may be required for the cast-in-place concrete work specified in Section 03300. Construct forms using facing materials required to provide the specified finishes and textures.

4. DESIGN OF FORMWORK:

A. Design, erect, support, brace and maintain formwork so that it will safely support all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Carry vertical and lateral loads to the ground by the formwork system and by the in-place construction that has attained adequate strength for that purpose. Construct formwork so that concrete members and structures are of the correct size, shape, alignment, elevation and position. **Design of formwork, shoring, and reshoring and its removal is the contractor's responsibility.**

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 –CONCRETE

B. Design forms and false work to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

C. Provide shores and struts with positive means of adjustment capable of taking up all formwork settlement during concrete placing operations, using wedges or jacks or combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

D. Support form facing materials by structural members spaced sufficiently close to prevent deflection of the form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to assure a smooth completed surface, free from irregularities and within the allowable tolerances.

E. Provide camber in formwork as required for anticipated deflections in formwork due to weight and pressure of fresh concrete and construction loads for long-span members without intermediate supports. Provide temporary openings in wall forms, column forms and at other locations necessary to permit inspection and facilitate clean-out.

F. Design formwork to be readily removable without impact, shock or damage to the cast-in-place concrete surfaces and adjacent materials.

G. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt all joints and provide backup material at joints as may be required to prevent leakage and fins.

H. Side forms of footings may be omitted and concrete placed directly-against the neat excavation only when requested by the Contractor and accepted by the Owner. When omission of forms is accepted, provide additional concrete required beyond the minimum design profiles and dimensions of the footings as detailed.

1. Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal framed plywood-faced or other panel type materials acceptable to the Architect, to provide continuous, straight, smooth exposed surfaces. Furnish in the largest practicable sizes to minimize number of joints and to conform to the joint system shown on the drawings. Provide form material with sufficient thickness to withstand the pressure of newly placed concrete without bow or deflection.

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

2. Unless otherwise shown or specified, use plywood complying with U.S. Product Standards PS-1, "B-B High Density Overlaid Concrete Form" Class I.

5. FORM MATERIALS:

A. Forms for Exposed Finish Concrete:

1. Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other panel type materials to provide continuous, straight, smooth exposed surfaces. Furnish in the largest practicable sizes to minimize number of joints and conform to the joint system shown on the drawings. Provide form material with sufficient thickness to withstand the pressure of newly placed concrete without bow or deflection.

Unless otherwise shown or specified, use plywood complying with U.S. Product Standard PS-1, "B-B High density Overlaid Concrete Form", Class I.

B. Forms for Unexposed Finish Concrete:

1. Form concrete surfaces which will be unexposed in the finished structure with plywood, boards, metal or other acceptable material. Provide lumber that is dressed on at least 2 edges and 1 side for a tight fit.

C. Forms for Textured Finish Concrete:

1. For textured finish concrete provide forms as required by the drawings, if any.

6. TOLERANCES FOR FORMWORK CONSTRUCTION:

- A. Construct formwork to provide completed concrete surfaces complying with the tolerances specified in ACI-347, Section 2.4, after removal of forms and prior to patching and finishing of cast-in-place formed surfaces.

7. FORM CONSTRUCTION:

A. General:

1. Construct forms complying with ACI-347, to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location grades, level and plumb work in the finished structure. Provide for opening, offsets, sinkages, keyways, recesses, moldings, rustication, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required on the work. Use selected materials to obtain the required finishes.

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

2. Fabricated forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Romero wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.
3. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent the loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible consistent with requirements of the work.
4. Where chamfer exposed external corners and edges occur use chamfer strips accurately fabricated to produce uniform smooth lines and tight edge joints. Provide chamfers of wood, metal, or PVC, to form the required corner or edge shapes as shown. Select one material and use throughout entire job.
5. Carefully form intersecting planes to provide true, clean-out corners.
6. Provide all openings in forms to accommodate other work, including mechanical and electrical work. Accurately place and securely support all items required to be built into the forms.

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

B. Falsework:

1. Erect falsework and adequately support, brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until each loads can be supported by the in-place concrete structure. Construct falsework so that adjustments can be made for take-up and settlement.
2. Provide suitable wedges, jacks or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine any abnormal deflection or signs of failure in the work; make necessary adjustments to produce work of the required dimensions.

C. Forms for Exposed Concrete:

1. Drill forms to suit the used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
2. Do not use metal cover plates for patching holes or defects in forms.
3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Provide back joints with extra studs or girds to maintain true, square intersections.
4. Provide extra studs, wailers and bracing as required to prevent bowing of forms between studs and to avoid a bowed appearance in concrete. Do not use narrow strips of form material which will produce bow.
5. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
6. Form molding shapes, recesses and projection with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

D. Form Ties:

1. Provide factory-fabricated, adjustable-length, removable or snap off metal form ties, designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal.

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

2. Unless otherwise shown, provide ties so that the portion remaining within the concrete after removal of the exterior parts is at least 1-1/2" inside form the concrete surface. Unless otherwise shown, provide form ties which will not leave a hole larger than 1" diameter in the concrete surface.

3. Form ties fabricated in the project site and wire ties are not acceptable.

4. At concrete smooth finish where tie holes are indicated in the drawings cone holes shall be plugged with Burke snap lugs of the reveal type. They shall be pre-cast, high strength, cement compound plugs and shall be glued with snaplug bonder. Where holes are not indicated on drawings, plugs of the flush type shall be used.

E. Corner Treatment:

1. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise shown.

2. Where chamfered corners occur form chamfers with 3/4" x 3/4" strips, unless otherwise shown, accurately formed and surfaced to produce uniformly straight lines and right edge joints. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

3. Unexposed corners may be found either square or chamfered. See drawings.

F. Provisions for Other Trades:

1. Provide openings in concrete formwork to accommodate work of other trades. Size and location of openings, recesses and chases are the responsibility of the trade requiring such items. Accurately place and securely support items to be built into forms.

G. Cleanouts, Cleaning and Tightening:

1. Provide temporary opening in forms as required to facilitate cleaning and inspection. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed.

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

2. Retighten forms immediately after concrete placement as required to eliminate mortar leaks

8. PREPARATION OF FORM SURFACES:

A. Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of the form-coating compound manufacturer's direction. Do not allow excess form coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with the manufacturer's instructions.

B. Coat steel forms with a non-staining, rust-preventive form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

9. SHORES AND SUPPORTS:

A. Extend shoring from ground to roof for structures 4-stories or less, unless otherwise permitted.

B. Extend shoring at least 3-floors under floor or roof being placed for structures over 4- stories. Shore floor directly under floor placed, so that loads from construction above will transfer directly to these shores. Space out shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums if required to ensure the proper distribution of loads throughout the structure.

C. Perform removal of shores and reshoring in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support the work.

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

D. Remove forms from one girder at a time, and re-shore before other support is removed. After girders are re-shored, forms for one beam and its adjacent slab may be removed and immediately re-shored before other supports are removed.

E. All structures have been designed according to final behavior and conditions. However, during erection of same, certain conditions can arise for which the behavior or the structure has not been contemplated. Therefore, the contractor should provide at all time adequate shoring and reshoring until the design conditions have been met. If there is any doubt during any phase of the construction, please consult and/or notify the structural designers.

F. All structures have been designed according to final behavior and conditions. However, during erection of same, certain conditions can arise for which the behavior or the structure has not been contemplated. Therefore, the contractor should provide at all time adequate shoring and reshoring until the design conditions have been met. IF there is any doubt during any phase of the construction, please consult and/or notify the structural designers.

G. In flat-slab construction, allow shores for area within intersection of middle strips of each panel to remain in place during stripping and reshoring operation. After other shores in each panel are removed, place reshores at midpoints between columns and on column lines before next panel is stripped. Keep reshores in place until the concrete has obtained its required 28-day strength and heavy loads due to construction operations have been removed.

SECTION 03100 - CONCRETE FORMWORK

DIVISION 3 – CONCRETE

10. REMOVAL OF FORMS:

A. General:

Form and supports shall remain in place for not less than the following periods of time or earlier than the recommended by ACI 301 and ACI 347:

Walls	24 hrs.
Columns	24 hrs.
Sides of beams and girders	24 hrs.
Pan Joist forms 30 inch wide or fewer	3 days
Over 30 inch wide	4 days
Arch centers	14 days
Joist, beam, or girders under	
10-feet clear span between supports	7 days
10 to 20 feet clear span between supports	14 days
Over 20 feet clear span between supports, cantilevers	21 days
Floor slabs under 10-feet clear span between supports	4 days
10 to 20 feet clear span between supports	7 days
Over 20 feet clear span between supports	10 days

11. RE-USE OF FORMS:

A. Clean and repair the surfaces of forms that are to be re-used in the work, except that split, frayed, delaminated or otherwise damaged form facing material will not be acceptable.

Apply new form coating compound material to all concrete contact form surfaces as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure all joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to the owner.

12. SUBMITTALS:

A. Manufacturer's Data, Concrete Formwork:

1. Submit 2 copies of manufacturer's specifications and installation instruction for proprietary materials and items as may be required, including form coatings, manufactured form systems, ties, and accessories.

B. Shop Drawings, Concrete Formwork:

2. Submit shop drawings for the fabrication and erection of specific finished concrete surfaces as shown or specified. Show the general construction of the forms including jointing, any special formed joints or reveals, location and pattern of form tie placement, and other items which affect the exposed concrete visually.

*****END OF SECTION*****

1. RELATED DOCUMENTS:

The general provisions of the contract, including General and Special Conditions, apply to the work specified in this section.

2. DESCRIPTION OF WORK:

The extent of concrete reinforcement is shown on the drawings and in schedules.

The work includes fabrication and placement of reinforcement for cast in place architectural and structural concrete, including bars, welded wire fabric, ties and supports.

3. GENERAL:**Codes and Standards:**

Comply with the requirements of the following codes and standards, except as herein modified:

American Concrete Institute, ACI-315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures".

American Concrete Institute, ACI 318 "Building Code Requirements for Reinforced Concrete". (Latest Edition).

Concrete Reinforcing Steel Institute, "Manual of Standard Practice"

4. MATERIALS:**A. Reinforcing Bars:**

Comply with the requirements of ASTM-A-615 and with grades given on drawings.

B. Steel Wire:

Provide plain, cold-drawn, steel wire complying with ASTM-A-82.

C. Welded Wire Fabric:

Provide welded steel wire fabric for concrete reinforcement complying with ASTM A 185.

Furnish in flat sheets, not rolls, unless rolls are acceptable to the Architect.

D. Column Spirals: (If any)

Provide plain, cold-drawn wire complying with ASTM-A-82, or hotrolled rods for spirals complying ASTM-A-615.

F. Support for Reinforcement:

Provide supports for reinforcement including bolsters, chairs, spacers and other devices suitable for proper spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with PS-7-66. Wood, brick, and other devices will not be acceptable.

For slabs on grade, use supports with sand plates or horizontal runners where base materials will not support chair legs.

For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are hotdip galvanized, or plastic protected.

5. FABRICATION:

A. General:

Shop-fabricate reinforcing bars to conform to the required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors, do not re-bent or straighten reinforcement in a manner that will injure or weaken the material. The use of heat for this purpose will not be permitted.

B. Identification:

Deliver all reinforcement to the project site bundle, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to marking shown on placement diagrams.

C. Rejected Materials:

1. Deliver all reinforcement to project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to marking shown on placement diagrams.

2. Reinforcement with any of the following defects will not be permitted in the work:

a. Bends or kinks not indicated on drawings or final shop drawings.

b. Bars with reduced cross-section due to excessive rusting or other cause.

D. Fabricating and placing tolerances:

1. Bars used for concrete reinforcement shall meet the following requirements for fabricating tolerances:

- | | | |
|----|-----------------------------|-----------------------|
| a. | Sheared length: | plus or minus 1-inch |
| b. | Depth of truss bars: | plus 0, minus 1/2-in. |
| c. | Stirrups, ties, and spirals | |
| | | plus or minus 1/2-in. |
| d. | All other bends: | plus or minus 1 in. |

2. Bars shall be placed to the following tolerances:

a. Concrete over to formed surfaces: plus or minus 1/4 inch

b. Minimum spacing between bars: minus 1/4 inch

c. Top bars in slabs and beams:

- | | | |
|----|---|------------------------|
| 1. | Members 8 inches deep or less: | plus or minus 1/4 inch |
| 2. | Members more than 8 inches but not over 2 ft. deep: | plus or minus 1/2 inch |
| 3. | Members more than 2-feet deep: | plus or minus 1 inch |

d. Crosswise of members: spaced evenly within 2 inches

e. Lengthwise of members: plus or minus 2 inches

6. PLACING

A. General:

1. Comply with the specified codes and standards, and the Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement, placement and supports, and as herein specified.

2. Clean reinforcement to be free from loose rust, mill scale, earth, and other material which reduce or destroy bond with concrete.

3. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, bolsters, runners, spacers and hangers, as required.

4. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16 gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that ends are directed into the concrete, not toward exposed concrete surfaces.

5. Install welded wire fabric in long lengths as practicable. Lap adjoining pieces at least on full mesh and lace splices with 16 gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that ends are directed into the concrete, not toward exposed concrete surfaces. Do not make end laps between supporting beams. Offset and laps in adjacent widths to prevent continuous laps in either direction.

7. Provide sufficient numbers of supports and of strength to carry the reinforcement. Do not place reinforcing bars more than 2" beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

8. Space reinforcing bars to comply with ACI-318, Chapter 7.6. Reinforcing bars may be relocated as necessary to avoid interference with other reinforcement, conduit or other embedded items. However, if any reinforcing bar is moved a distance exceeding one bar diameter or the specified placing tolerance, the resulting rearrangement of the reinforcement will be subject to acceptance by the Owner.

B. Splices in Reinforcement:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. Comply with the requirements of ACI-318 Chapter 12.13 /12.20 for minimum lap of spliced bars, and with details shown on drawings.

7. SUBMITTALS

A. Manufacturer's Data, Concrete Reinforcement:

Submit 2 copies of manufacturer's specifications and installation instructions for all proprietary materials and reinforcement accessories.

B. Mill Certificates, Concrete Reinforcement:

Submit 2 copies of steel producer's certificates of mill tests for all reinforcing steel.

C. Shop Drawings, Concrete Reinforcement:

Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with the ACI-313 "Manual of Standard Practice for Detailing Reinforced Concrete Structures", showing bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement. Include all special reinforcement required and openings through concrete structures. Show wall reinforcement as elevations drawn at a scale of not less than 1/4" to 1' - 0".

8. SAMPLING AND TESTING

The contractor shall employ, at his own expense, a testing laboratory (preferably the same used for concrete testing) accepted by the architect/owner to perform the tests hereinafter specified and to submit test reports to the owner. The testing laboratory shall be responsible for conducting and interpreting the tests, and shall state in each report whether or not the test specimens comply with the specified requirements, and shall indicate any deviations.

Test reinforcement for tensile and bending requirements set forth in ANSI/ASTM A-613 and tables 2 and 3 from that standard.

Disregard article 10 Number of Tests from ASTM Standard. Take one set of three 30" long samples for each bar size from each truck even if the reinforcement is already bent.

*****END OFF SECTION*****

1. RELATED DOCUMENTS

The general provisions of the contract, including General Conditions and Special Conditions (if any), apply to the work specified in this section.

2. DESCRIPTION OF WORK

The extent of cast-in-place concrete work is shown on the drawings.

The work includes providing cast-in-place concrete consisting of portland cement, fine aggregate, coarse aggregate, water, admixtures; designed, proportioned, mixed, placed, finished and cured as herein specified.

The following types of cast-in-place concrete as specified in this section:

A. Standard weight concrete

3. GENERAL**A. Codes and Standards:**

1. Comply with the provisions of the following codes, specifications and standards, (latest edition) except as otherwise shown or specified:

ACI-301	"Specifications for Structural Concrete for Buildings"
ACI-318	"Building Code Requirements for Reinforced Concrete"
ACI-614	"Recommended Practice for Measuring, Mixing and Placing Concrete"
ACI-311	"Recommended Practice for Concrete Inspection"

B. Workmanship:

1. All concrete work which does not conform to the specified requirements including strength, tolerances, and finishes, shall be corrected as directed by the owner at the Contractor's expense, without extension of time therefore. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

C. Qualifications of Contractor's Testing Laboratory:

1. Contractor's selection of a testing laboratory is subject to the owner acceptance.
2. Select a testing laboratory thoroughly experienced in design and testing of concrete materials and mixes. Submit a written description of the proposed concrete testing laboratory giving qualifications of personnel, laboratory facilities and may be requested by the owner.

4. CONCRETE MATERIALS**A. Portland Cement:**

1. Comply with the requirements of ASTM-C-150.
2. Only one brand of cement may be used for each required type throughout the project, unless otherwise accepted by the Owner.

B. Aggregates:

1. Comply with the requirements of ASTM-C-33 and as herein specified.
2. Do not use aggregates containing soluble salts or other substances such as iron sulphide, pyrite, marcasite or ochre which can cause stains on exposed concrete surfaces.
3. Provide aggregates from a single source for all exposed aggregate finish and exposed architectural concrete.
4. Fine aggregate shall be clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
5. Coarse aggregate shall be clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
 - a. Crushed stone, processed from natural rock or stone.
 - b. Washed gravel, either natural or crushed with water that is clean, fresh and free of oil, acid, organic matter or other deleterious substances.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

c. Use size 57 (maximum aggregate size 1") for columns, beams and other concrete, except as otherwise specified.

C. Water:

Provide water for mixing and curing that is fresh and does not contain impurities in sufficient amount to etch concrete surfaces, or cause discoloration to concrete indicated to remain exposed and unpainted.

5. CONCRETE ADMIXTURES

A. Provide admixtures produced by recognized admixture manufacturers and use in compliance with the manufacturer's printed directions. Do not use admixtures which have not been incorporated and tested in the accepted design mixes, unless otherwise authorized in writing by the owner.

B. Air-entraining admixtures shall comply with the requirements of ASTM-C-260.

C. Water reducing set retarding admixtures shall comply with the requirements of ASTM-C-494.

D. Do not use calcium chloride in concrete, except as otherwise authorized in writing by the owner. Do not use any admixtures containing calcium chloride where concrete is placed against nay galvanized steel, or in any mix using high-early strength cement.

E. All concrete that is to be left exposed shall be poured with a superplasticiser admixture producing a slump of 8" X 1". Product shall comply with ASTM Specification C-1017 and C-494G. Admixture shall be controlled and readily dispensed at the batch plant.

F. Product to be used shall be Master Builder Pozzoloth 440 superplasticiser. The mix shall contain a proportion of 10-12 fluid ounces of Pozzoloth 440 for each 100-pounds of cement.

6. JOINT MATERIALS

A. Waterstops:

Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints where no movement is expected, unless otherwise shown; having a web thickness of not less than 3/16" for units up to 5" wide, and having a web thickness of not less than 3/8" for widths 3" and over.

Provide polyvinyl chloride (PVC) waterstops complying with Corps of Engineers CRD-C572.

7. SUBGRADE COVER MATERIALS:

A. Unless otherwise shown on drawings, provide water barrier cover over subgrade materials under building slabs on ground as follows:

Use clear polyethylene sheeting, 0.006" (6 mils) thick, complying with CS-238. Materials shall be resistant to decay when tested in accordance with ASTM-E-134

8. BONDING MATERIALS

A. Provide an aqueous phase, film forming, concrete bonding agent, compound suitable for brush or spray application complying with Mil B-19235.

9. FLOOR FINISH MATERIALS

A. Liquid Chemical Floor Hardener:

Provide a colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicate per gallon.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

Products offered by manufacturers to comply with the requirements for colorless liquid chemical floor hardener include the following:

Sciolith:	Chem-Master Corp.
Euco Surhard:	Euclid Chemical Co.
Hornolith:	A.C. Horn/W.R. Grace
Saniseal 50:	Master Builders Co.
Lapidolith:	Sonneborn Bldg. Products
RIW Flintox Liquid:	Toch Bros.

A. Abrasive Aggregate for Non-Slip Finish:

Fused aluminum oxide Grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing less than 40% aluminum oxide and not less than 25% ferric oxide.

Use material that is factory-graded, packaged, rust-proof and non glazing, and is unaffected by moisture and cleaning materials.

B. Dry Shake Materials for Colored Wear - Resistant Finish:

Where shown on drawings provide packaged, dry, combination of materials formulated for producing colored and wear resistant monolithic surface treatments, consisting of Portland Cement, graded quartz aggregate, coloring pigments, and dispersing agents. Use coloring pigments that are finely ground, non-fading mineral oxides, interground with the cement, as selected by the Architect unless otherwise shown.

10. CONCRETE CURING MATERIALS:**A. Absorptive Cover:**

Provide absorptive cover for curing concrete consisting of burlap cloth made from jute or kenaf, weighing approximately 9 oz. per square yard and complying with AASHTO-M-182, Class 3, or provide cotton mats complying with ASTM-C-440.

B. Moisture-Retaining Cover:

Provide moisture retaining cover for curing concrete of any of the following:

1. Waterproof paper, complying with ASTM-C-171, Type 1 or 2 Type 2.
2. Polyethylene sheeting, complying with AASHTO-M-171.
3. Polyethylene - coated burlap.

C. Membrane-Forming Curing Compound:

1. Provide a liquid type membrane-forming curing compound complying with ASTM-C-309.
2. Use Type 1, clear with fugitive dye, for interior and exterior surfaces to receive applied finishes.

11. CONCRETE SAMPLING AND TESTING**A. Concrete Testing Service:**

The Contractor shall employ, at his own expense, a testing laboratory accepted by the owner, to perform all other tests and to submit test reports to the owner. The testing laboratory shall be responsible for conducting and interpreting the tests, and shall state in each report whether or not the test specimens comply to the specified requirements and shall indicate any deviations there from.

Materials and installed work may require testing and retesting as directed by the owner at anytime during the progress of the work. Allow free access to material stockpiles and facilities at all times.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

Tests, not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.

B. Tests for Concrete Materials:

1. Sample and test proposed concrete materials for design concrete mixes as listed below:

Test fine aggregate from each material source and report the following:

Sieve Analysis	ASTM-C-136
Fineness Modulus	ASTM-C-125
Material Passing No. 200 Sieve	ASTM-C-117
Amount of Friable Particles	ASTM-C-142
Amount of Organic Impurities	ASTM-C-40
Magnesium Sulphate Soundness Tests	ASTM-C-88

2. Test coarse aggregate from each material source and each grading, and report the following:

Sieve Analysis	ASTM-C-136
Fineness Modulus	ASTM-C-125
Amount of Friable Particles	ASTM-C-142
Amount of Soft Particles	ASTM-C-235
Material Passing No. 200 Sieve	ASTM-C-117
Magnesium Sulphate Soundness Tests	ASTM-C-88
Compacted Unit Weight	ASTM-C-29
Los Angeles Abrasion Test	ASTM-C-131 and ASTM-C-335

3. Test Portland Cement from each material source, type and color, and report the following:

Chemical Analysis	ASTM-C-114
Fineness of Grind	ASTM-C-115 or ASTM-C-204
Autoclave Expansion	ASTM-C-151
Time of Setting	ASTM-C-266
Air Content of Mortar	ASTM-C-185

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

Compressive Strength	ASTM-C-109
Heat of Hydration	ASTM-C-186
False Set	ASTM-C-451

Submit written reports to the owner for each material sampled and tested prior to the start of work. Provide the project identification name number, date of report, name of contractor, name of concrete testing service, source of concrete aggregates, manufacturer and brand name for manufactured material, values specified in the referenced specification for each material, and test results.

C. Quality Control Testing During Construction:

1. Concrete shall be sampled and tested for quality control during the placement of concrete as follows:

a. Sampling Fresh Concrete ASTM-C-172

Except modified for slump to comply with ASTM-C-94

b. Slump ASTM-C-143

One test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.

c. Compression Test Specimens ASTM-C- 31

One set of 6 standard cylinders for each compressive strength test.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

d. Concrete temperature: Test hourly when air temperature is 80°F. and above; and each time a set of compression test specimens is made.

e. Compressive Strength Test: ASTM-C-39; one set for each 100 cu. yards or fraction thereof, or each concrete class placed in any one day; 2 specimens tested at 7-days, 3 specimens tested at 28-days, and one specimen retained in reserve for later testing if required.

f. Test results shall be reported in writing to the owner and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28-days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

D. Additional Tests:

The testing service shall take core samples of in-place concrete when test results are such that the specified concrete strengths and other characteristics have not been attained in the structure. The testing service shall conduct tests to determine the strength and other characteristics of the in-place concrete by compression tests on cored cylinders complying with ASTM-C-42, or by load as outlined in ACI-318, or other as directed. The Contractor shall pay for such tests conducted and any other additional testing as may be required.

12. PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type of concrete shown and specified. Proportion design mixes by weight for each class of concrete required, complying with ACI-613

"Recommended Practice for Selecting Proportions for Concrete", and report the following data:

1. Complete identification of aggregate source of supply.
2. Tests of aggregates for compliance with specified requirements.
3. Scale weight of each aggregate.
4. Absorbed water in each aggregate.
5. Brand, type and composition of cement.
6. Brand, type and amount of each admixture.
7. Amount of water used in trial mixes.
8. Proportions of each material per cubic yard.
9. Gross weight and yield per cubic yard of trial mixtures

B. Compressive strength developed at 7-days and 28-days, from not less than 3 tests cylinders cast for each 7 and 28-day test, and for each design mix.

C. Submit written reports to the owner of each design mix for each type and class of concrete, at least 13 calendar days prior to the start of the specified work. Include in each report the project identification name and number, date of report, name of contractor, name of concrete testing service, concrete class, source of concrete aggregates, manufacturer and brand name of manufactured materials, the precise proportions of specified herein for the type and class of concrete, and the test results for each property specified for the design mix.

The criteria specified herein are maximums or minimums, and shall not be construed to pre-determine fixed quantities of materials in the mix design, or to preclude change of an accepted mix design at any time.

Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the Owner and as accepted by the Owner. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by the Owner, before using in the work.

13. CONCRETE MIXES

A. Provide the classes of concrete shown on the drawings.

B. Use water-reducing admixtures in strict compliance with the manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used at the Contractor's option subject to the Owner's acceptance.

C. When admixtures are used, a reduction in the specified minimum cement content of concrete mixes will not be permitted.

D. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities of admixtures as required to maintain quality control.

E. Proportion and design mixes to result in concrete slump at the point of placement as follows:

1. Ramp and Sloping Surfaces: Not more than 3".
2. Reinforced Foundation Systems: Not less than 1" and not more than 3"
3. All other concrete: Not less than 1" And not more than 4"

14. SAMPLE SECTIONS FOR CONTROL OF FINISHES:

The continuity of color exposed concrete surfaces is of prime importance. Maintain such controls and procedures, in addition to those specified, as necessary to provide the specified finish surfaces.

Architect's Samples:

Samples of finishes acceptable to the Owner shall be made available by the Contractor before starting the work. Coordinate the procurement and selection of all materials, and the design and mixing of all concrete in order to obtain the acceptable color and finish in the completed structures.

Field Constructed Samples:

Fabricate sample sections representative of the specified finish surfaces, in locations as directed by the Architect. Form, reinforce, mix, cast, cure and finish the sample units using selected materials approved for the work and construction methods proposed for the work. Provide sample sections as follows:

Construct a wall section of "L" shape panels, approximately 4' high X 3' each side X 6" thick, unless otherwise indicated by Owner. Form faces to represent as-cast surface finish. Include not less than 2 form ties, form panel intersection, one vertical construction joint and one horizontal construction joint.

Construct a column section approximately 4' high and not less than 12" diameter for round sections and not less than 12" in least dimensions for rectangular sections, unless otherwise directed by Owner. Chamfer the exposed edges of rectangular sample columns as required.

Do not remove sample sections without written permission from the Owner. When directed, demolish sample sections and remove from the site.

15. JOINTS

A. Construction Joints:

- 1.** Locate and install construction joints, which are not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the Owner. Locate construction joints, if required but not shown, as follows:
- 2.** In walls, at not more than 60-feet in any horizontal direction; at top of footings; at top of slabs on ground; at top and bottom of door and window openings or as required to conform to architectural details as directed by the Owner; and at the outside of the deepest beam or girder framing into wall.
- 3.** In columns or piers, at the top of footing; at the top of slabs on ground; and at the underside of the deepest beam or girder framing into the column or pier, or to conform to architectural details.
- 4.** In slabs on ground, so as to divide the slab into areas not in excess of 1,200 square feet, unless otherwise accepted by the Owner. Conform to slab placement diagrams or pattern layout for placement, where shown.
- 5.** Provide keyways at least 1-1/2" deep where called for, and as shown on the drawings.
- 6.** Provide waterstops in construction joints as shown on the drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to support and protect waterstops during the progress of the work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any joint.

B. Isolation Joints in Slabs on Ground:

1. Provide insulation joints in slabs on ground at all points of contact between slabs on ground and vertical surfaces. These joints shall be of pre-molded expansion- joint filler strips. Unless otherwise noted or specified, such joints shall be 1/2 inch thick and the full depth of slab.

C. Control Joints in Slab on Ground:

1. Provide control joints in slabs on ground to form panels or patterns as shown. Use inserts 1/4" wide 1/5 to 1/4 of the slab depth, unless otherwise shown.

2. Form control joints by inserting a pre-molded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the slab surface. After the concrete has cured for at least 7 days, remove inserts and clean groove of loose debris.

16. INSTALLATION OF EMBEDDED ITEMS**A. General:**

1. Set and build into the work anchorage devices and other embedded items required the other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instruction and directions provided by suppliers of the items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs:

1. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the type of screeds required. Align the concrete surface to the elevation of the screed strips by the use of strike-of templates or accepted compacting type screeds.

C. Metal Inserts:

1. Provide metal inserts for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work.
2. Provide adjustable wedge inserts of malleable cast iron, furnished complete with full depth bolts; 3/4 bolt size, unless otherwise shown.
3. Provide threaded inserts of malleable cast iron, furnished completed with full-depth bolts; 3/4" bolt size, unless otherwise shown.
4. Provide flashing reglets formed of sheet metal of the same type and gauge as the flashing metal to be built into the reglet, where shown. Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 20 gauge galvanized sheet steel. Size, shape and install as detailed. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

17. CONCRETE MIXING**A. General:**

1. Concrete may be mixed at batch plants or it may be transit-mixed as specified herein. Batch plants must comply with the requirements of ACI-614, with sufficient capacity to produce concrete of the qualities specified in quantities required to meet the construction schedule. All plant facilities are subject to the acceptance of the Owner.

B. Job Site Mixing:

1. Mix all materials for concrete in an acceptable drum type batch machine mixer. For mixers of one cubic yard, or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5-minutes after all ingredients are in the mixer, before any part of the batch is released. For mixers of capacity larger than one cubic yard, increase the minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof. Do not exceed the catalog rating or name-plate capacity for the total volume of materials used per batch. Equip the mixer with automatic controls, or semi-automatic controls if acceptable, for proportioning materials and the proper measured quantities. Do not exceed 30

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

minutes total elapsed time between intermingling of damp aggregates and cement to the discharge of the completed mix.

2. Provide a batch ticket for each batch discharged and used in the work indicating the project identification name and number, date, mix type, quantity and amount of water introduced.

C. Ready-mix Concrete:

1. Comply with the requirements of ASTM-C-94, and as herein specified, provided the quantity and rate of delivery will permit unrestricted progress of the work in accordance with the placement schedule. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM-C-94 may be required, as specified below. Proposed changes in mixing procedures, other than herein specified, must be accepted by the Owner before implementation.

D. Modification to ASTM-C-94 are as follows:

1. Quality of Concrete:

Provide concrete materials, proportions, and properties as herein specified, in lieu of ASTM Section 4.

2. Tolerances in Slump:

Provide slump of not more than the values as herein specified, in lieu of ASTM Section 5.1. Comply with other criteria of ASTM Section 5.

3. Mixing and Delivery:

Delete the references for allowing additional water to be added to the batch for material with insufficient slump. Addition of water to the batch will not be permitted as specified in ASTM Section 9.7. In addition to the requirements of ASTM Section 9.7, when the air temperature is between 85°F., and 90°F., reduce the mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90°F., reduce the mixing and delivery time to 60 minutes. When a truck mixer is used the complete mixing of the concrete, begin the mixing operation within 30 minutes after the cement has been intermingled with the aggregates.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

4. Certification:

Furnish duplicate delivery tickets with each load of concrete delivered to the site, one for the Owner and one for the Contractor. In addition to the requirements of ASTM Section 14.1, provide the following information on delivery tickets:

- a) Type and brand of cement.
- b) Cement content (in 94-lbs. sacks) per cubic yard of concrete.
- c) Maximum size of aggregate.
- d) Amount and brand name of each admixture.
- e) Total water content expressed as water/cement ratio.

5. Strength:

Delete ASTM Section 15; comply with concrete testing requirements as herein specified.

Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery in order to prevent delay of placing the concrete after mixing, or holding dry-mixed materials too long in the mixer before the addition of water and admixtures.

18. CONCRETE PLACEMENT

A. General:

1. Place concrete in compliance with the practices and recommendations of ACI-614, and as herein specified.

2. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.

3. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

4. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use re-tempered concrete. Remove rejected concrete from the project site and dispose of in an acceptable location.

B. Pre-Placement Inspection:

1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work, as required. Thoroughly wet wood forms immediately before placing concrete, as required where form coating are not used.

C. Concrete Conveying:

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the location of final deposit as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials.

2. Provide mechanical equipment of such size and design for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposits. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, and other deleterious materials.

D. Placing Concrete in Forms:

1. Deposit concrete in forms in horizontal layers not deeper than 18" and in a manner to avoid inclined construction joints

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

- 2.** Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
- 3.** Consolidate all concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use vibrators designed to operate with vibratory element submerged in concrete, maintaining a speed of not less than 6000 impulses per minute when submerged in the concrete. Vibration of forms and reinforcing will not be permitted, unless otherwise accepted by the Owner.
- 4.** Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
- 5.** Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.
- 6.** Do not place concrete in supporting elements until the concrete previously placed in columns and walls is no longer plastic.

E. Placing Concrete Slabs:

- 1.** Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs, and against bulkheads of slabs on ground, as specified for formed concrete structures. Consolidate concrete in the remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other acceptable methods. Limit the time of vibrating consolidation to prevent bringing an excess of fine aggregate to the surface.

3. Bring slab surfaces to the correct level with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

4. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

F. Bonding:

1. Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent, and clean surfaces of laitance, coating, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and do not leave laitance, loose particles of aggregate, or damaged concrete at the surface.

2. Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:

3. At joints between footings and walls or columns, and between walls or columns and beams of slabs they support, and elsewhere unless otherwise specified herein, dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete.

4. At joints in exposed work; at vertical joints in walls; at joints in girders, beams, supported slabs and other structural members; and at joints designed to contain liquids, dampen, but do not saturate, the roughened and cleaned surface of set concrete and apply a liberal coating of neat cement grout.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

5. Use neat cement grout consisting of equal parts portland cement and fine aggregate by weight and not more than 6-gals. of water per sack of cement. Apply with a stiff broom or brush to a minimum thickness of 1/16". Deposit fresh concrete before cement grout has attained its initial set.

6. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instructions of the bonding material manufacturer.

7. Prepare for bonding of fresh concrete to fully-cured hardened concrete or existing concrete by using an epoxy-resin adhesive binder, as follows:

a. Handle and store epoxy-resin adhesive binder in compliance with the manufacturer's printed instructions, including safety precautions.

b. Mix the epoxy-resin adhesive binder in the proportions recommended by the manufacturer, carefully following directions for safety of personnel.

c. Before depositing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy-resin grout not less than 1/16" thick. Place fresh concrete while the epoxy-resin material is still tacky, without removing the in-place grout coat, and as directed by the epoxy-resin manufacturer.

G. Hot Weather Placing: Concrete deposited in hot weather shall not have a placing temperature over 90 F.

19. FINISH OF FORMED SURFACES

A. Standard Rough Form Finish:

1. Provide as-cast rough form finish to formed concrete surfaces that are to be concealed in the finish work or by other construction, unless otherwise indicated.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and all fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Standard Smooth Finish (SSF):

1. Provide standard smooth finish for all concrete formed surfaces that are to be covered with a coating material applied directly to the concrete or a covering material bonded to the concrete such as waterproofing, damp-proofing, painting, or other similar system, unless otherwise shown or specified.

C. Architectural Exposed Concrete Finish (When applicable):

1. Provide where shown on the drawings, architectural exposed concrete finish.

2. Architectural exposed concrete finish shall be the as-cast concrete surface as obtained with the form facing material. Absolutely no patching will be permitted. Formed concrete must conform with the exact shapes and dimensions shown on drawings and shall be free of imperfections affecting the intended appearance.

a. Exposed Textured Finish Concrete (TFC). TFC shall show the texture of the form required by the drawings.

b. Exposed Smooth Finish Concrete (SFC). SFC shall be as smooth as the form facing material. Fins and other projections on the surface shall be completely removed and smoothed.

D. Bush Hammer Concrete Finish:

1. Bush hammering shall be executed using a Kanyo hammer with disk type head or a Kanyo hammer with roller type head. Arises shall be rounded with the same finish as large surfaces. Toll the concrete surface at least 1/8" deep so that coarse aggregate shows uniformly.

2. Tests shall be made before starting operation for the Architect's inspection and approval

3. When directed by the Architect remove and replace concrete not meeting the above requirements.

E. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

20. MONOLITHIC (INTEGRAL) SLAB FINISHES

A. Scratch Finish:

1. Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping (applied cement finish) or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as shown on the drawings.

2. After placing slabs, plane the surface to a tolerance not exceeding 1/4" in 2" when tested with a 2" straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen the surface before the final set with stiff brushes, brooms or rakes.

B. Float Finish:

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and as shown on the drawings or in schedules.

2. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float, or both. Consolidate the surface with power-driven floats, or by hand-floating of area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding 1/4" in 10" when tested with a 10' straightedge placed

on the surface at not less than 2 different angles. Cut down light spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to the uniform smooth, granular texture.

3. Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring paint, or other thin-film finish coating system.

4. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.

5. Consolidate the concrete surface by the final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8" in 10' when tested with a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

C. Non-Slip Aggregate Finish:

1. Apply non-slip aggregate finish to concrete stair treads, platforms, ramps, and elsewhere as shown on the drawings or in schedules.

2. After completion of float finishing, and before starting trowel finish, uniformly spread 25-lbs. of dampened non-slip aggregate per 100 square feet of surface. Tamp aggregate flush with the surface using a steel trowel, but do not force the non-slip aggregate particles below the surface. After broadcasting and tamping, apply trowel finishing as herein specified.

3. After curing, lightly work the surface with a steel wire brush, or a abrasive stone, and water to expose the non-slip aggregate.

D. Non-Slip Broom Finish:

1. Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as shown on the drawings or in schedules.

2. Immediately after trowel finishing, slightly roughen the concrete surface by

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

brooming in the direction perpendicular to the main traffic route. Coordinate the required final finish with the Owner before application.

E. Integral Colored Concrete:

1. Integrally color concrete shall be provided at all pedestrim walls and paved areas, except street sidewalks and curbs and/or unless otherwise indicated on drawings.
2. Use CEROMIX admixture as manufactured by L.M. Scofield Company of color selected by the Owner or approved equal.
3. Concrete shall be mixed at plant following manufacturer's recommendations. Contractor shall pour a field sample for determining color and texture of finish. Broom finish all surfaces in one direction and protect adjacent areas from staining with colored concrete.

F. Colored Wear-Resistant Finish:

1. Provide colored wear-resistant finish to monolithic slab surfaces and applied cement finishes where shown on the drawings or in schedules.
2. Apply dry shake material for colored wear-resistant finish at the rate of not less than 60-lbs. per 100-sq. ft., unless greater amount is recommended by the material manufacturer.
3. Immediately following the first floating operation, uniformly distribute approximately 2/3 of the required weight of dry shake material over the concrete surface, and embed by means of power floating. After the first dry shake application, uniformly distribute the remainder of the dry shake material at right angles to the first application, and embed by power floating.
4. After completion of broadcasting and floating, apply a trowel finish as herein specified.

21. CONCRETE CURING AND PROTECTION

A. General:

1. Protect freshly placed concrete from premature drying and excessive hot

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

2. Start initial curing as soon as free water has disappeared from the concrete surface after placing and finishing. Keep continuously moist for not less than 72-hours.

3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 168 cumulative hours (not necessarily consecutive) during which the concrete has been exposed to air temperature above 50°F. Avoid rapid drying at the end of the final curing period.

B. Curing Methods:

1. Provide moisture curing by any of the following methods:

- a) Keep the surface of the concrete continuously wet by covering with water.
- b) Continuous water-fog spray.
- c) Covering the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 4" lap over adjacent absorptive covers.

2. Provide moisture-cover curing as follows:

Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete, placed in the widest practicable width with side and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

3. Provide membrane curing as follows:

Apply the specified membrane-forming curing compound to damp concrete surfaces as soon as the water film has disappeared. Apply

uniformly in a 2-coat continuous operation by power spray equipment in accordance with the manufacturer's directions. Re-coat areas which are subjected to heavy rainfall within 3 hours after initial application.

Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Do not use membrane curing compounds on surfaces which are to be covered with a coating material bonded to the concrete, such as other concrete, liquid floor hardener, waterproofing, damp-proofing, membrane roofing, flooring, painting, and other coatings and finish materials.

4. Curing Formed Surfaces:

Cure formed concrete surfaces, including the undersides of girders, beams supported slabs and other similar surfaces by moist curing with the forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by any of the methods specified above, as applicable.

5. Curing Unformed Surfaces:

Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing.

Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.

Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

6. Temperature of Concrete During Curing:

When the atmospheric temperature is 80°F. and above, or during other climatic conditions which will cause too rapid drying of the concrete make arrangements before the start of concrete placing for wet sprinkling, or moisture-retaining covering. Protect the concrete continuously for the concrete period. Provide hot weather protection complying with the requirements of ACI-605.

Maintain concrete temperature as uniformly as possible, and protect from rapid atmospheric temperature changes. Avoid temperature changes to concrete which exceed 5°F. in any one hour.

7. Protection from Mechanical Injury:

During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

22. MISCELLANEOUS CONCRETE ITEMS**A. Filling In:**

1. Fill-in holes and openings left in concrete structures for the passage of work by other trades, unless otherwise shown as directed, after the work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place

construction. Provide all other miscellaneous concrete filling shown or required to complete the work.

B. Curbs:

1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersection, and termination slightly rounded.

C. Equipment Bases and Foundations:

1. Provide machine and equipment bases and foundations, when shown on the drawings. Set anchor bolts for machines and equipment to complete at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

23. CONCRETE EVALUATIONS

A. Evaluation of Quality Control Tests:

1. The concrete quality control testing as hereinafter specified will be evaluated by the following criteria.

2. Do not use concrete delivered to the final point of placement which has a slump outside the values specified.

3. Strength of working stress type concrete shall be considered satisfactory if the average of five consecutive strength tests of the laboratory cured specimens representing each specified strength of concrete is equal to or greater than the specified strength, and if no more than 20 percent of the strength tests have values less than the specified strength, and no individual strength test result falls below the required strength by more than 500-psi.

4. Strength tests of specimens cured under field conditions may be required by the Owner to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded by the field quality control laboratory at the same time and from the same samples as the laboratory cured specimens.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

5. Provide improved means and procedures for protecting concrete when the 28-day compressive strength of field-cured cylinders is less than 85% of companion laboratory-cured cylinders.
6. When laboratory-cured cylinder strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the minimum required compressive strength by more than 500 psi, even though the 85% criterion is not met.
7. If individual tests of laboratory-cured specimens produce strengths more than 500 psi. below the required minimum compressive strength, or if tests of field-cured cylinders indicate deficiencies in protection and curing, provide additional measures to assure that the load-bearing capacity of the structure is not jeopardized. If the likelihood of low-strength concrete is confirmed and computations indicated the load-bearing capacity may have been significantly reduced, tests of cores drilled from the areas in question may be required.
8. If the compressive strength tests fail to meet the minimum requirements specified, the concrete represented by each tests will be considered deficient in strength and subject to additional testing as herein specified.
9. Strength of ultimate strength type concrete shall be considered satisfactory if the average of any three consecutive strength tests of the laboratory cured specimens representing each specified strength of concrete is equal to or greater than specified strength, and if not more than 10 percent of the strength tests have values less than the specified strength and no individual strength test result falls below the required strength by more than 500-PSI.

B. Formed Concrete Dimensional Tolerances:

1. Formed concrete having any dimension smaller or greater than required, and outside the specified tolerances limits, will be considered deficient in strength and subject to additional testing as herein specified.
2. Formed concrete having any dimension greater than required will be rejected if the appearance or function of the structure is adversely affected, or if the larger dimension interfere with other construction. When permitted, accomplish the removal of excessive material in a manner to maintain the strength of the section without affecting function and appearance.

C. Strength of Concrete Structure:

1. The strength of the concrete structure in-place will be considered potentially deficient if fails to comply with any of the requirements which control the strength of structure, including the following conditions.
2. Failure to meet compressive strength tests requirements.
3. Concrete which differs from the required dimensions or location in such a manner to reduce strength.
4. Concrete subjected to damaging mechanical disturbances; particularly load stresses, heavy shock, and excessive vibration.
5. Poor workmanship and quality control likely to result in deficient strength.

D. Testing Concrete Structure for Strength:

1. When there is evidence that the strength of the concrete structure in-place does not meet specification requirements, the concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM-C-42 and as follows:
2. Take at least 3 representative cores from each member or area of suspect strength, from locations directed by the Owner.
3. Test cores in a saturated-surface-dry condition per ACI-318 if the concrete will be wet during the use of the completed structure.
4. Test cores in an air-dry condition per ACI-318 if the concrete will be dry at all times during use of the completed structure.
5. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85% and no single core is less than 75% of the 28-day required compressive strength.
6. Report tests results in writing to the Owner, on the same day that tests are made.

7. Include in test reports the project identification name and number, date, name of Contractor Testing Service, location of test core in a structure, type or class of concrete represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plane of the concrete as placed, and the moisture condition of the core at time of testing.
8. Fill core holes solid with non-shrinking patching mortar, with identical compressive strength as the specified for the concrete meter and finish to match adjacent concrete surfaces.
9. Conduct static load tests and evaluation complying with ACI-318 if the results of the core tests are unsatisfactory, or if core tests are impracticable to obtain, as directed by the Owner.
10. Correct all concrete work that is found structurally inadequate by core tests or by results of static load tests, as directed by the Owner.

24. CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

1. Repair and patch defective areas with cement mortar immediately after removal of forms, but only when directed by the Owner.
2. Cut out honeycomb, rock pockets, voids over 1/2" diameter, and holes left by tie rods and bolts, down to solid concrete but, in no case, to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Owner.
3. Fill holes extending through concrete by means of a plunger-type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.

B. Repair of Formed Surfaces:

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

1. Repair exposed concrete surfaces that contain defects which adversely affect the appearance of the finish only with the approval of the Owner. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the Owner. Surface defects, as such include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface and stains and other discolorations that cannot be removed by cleaning.

2. Repair concealed formed concrete surfaces, where possible, that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects, as such, include cracks in excess of 0.01" wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced section, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corners.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.

2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.

3. Repair finished unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

4. Correct high areas in unformed surfaces by grinding, after the concrete has cured at least 14-days.

5. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Owner

6. Repair defective areas, except random cracks and single hole not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4" clearance all around. Dampen all concrete surfaces in contact with patching concrete, and brush with a neat cement grout coating or concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same material to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

7. Repair isolated random cracks and single holes not over 1" in diameter by the dry- pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72-hours.

8. Repair methods not specified above may be used, subject to the acceptance of the Owner.

25. SUBMITTALS

A. Manufacturer's Data:

1. Submit 2 copies of manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures, bonding agents, epoxy-resin grout, patching compounds, waterstops, joint systems, chemical floor hardeners, and dry shake finish materials.

SECTION 03300 - CAST-IN-PLACE CONCRETE

DIVISION 3 - CONCRETE

B. Samples, Cast-In-Place Concrete:

1. Submit samples of materials as specified and as otherwise may be requested by the Owner, including names, sources and description as required.
2. Provide sample panels as herein specified under "Sample Sections for Control of Finishes". Perform revisions and corrective work required to produce finished concrete and surfaces as required by the Owner. Construct additional sample panels as may be required if original results are not satisfactory to the Owner.

C. Laboratory Test Reports, Cast-In-Place Concrete:

1. Submit 2 copies of laboratory test report for concrete materials and mix design tests as specified herein to the Owner.

D. Material Certificates, Cast-In-Place Concrete:

1. Provide materials certificates in lieu of materials laboratory test reports only when permitted by the Owner. Material certificates shall be signed by the material manufacturer and the Contractor, certifying that each material item complies with, or exceeds, the specified requirements.

*****END OF SECTION*****

Section 03 01 30- Strengthening of Concrete with Fiber Reinforced Polymer, FRP Reinforcement

PART 1 - GENERAL

1.1 Related Documents

- A. The Conditions of the Contract for Construction and the General Requirements of Division 1 of these Specifications apply to the Work in this Section.

1.2 Work Included

- A. The Work of this Section shall include furnishing all labor, materials, equipment, and supervision to prepare the surface of the structural concrete members and to install the FRP Reinforcement as indicated on the Drawings.

1.3 Related Work

- A. The following work is related to this Section:

- | | |
|--------------------|--|
| 1. Concrete Repair | Section 03 01 30.71 (cast-in-place concrete) |
| 2. Epoxy Injection | Section 03 64 23 |

1.4 Reference Standards

- A. Comply with the following reference standards, except where more stringent requirements are indicated on the Drawings or specified herein:

1. American Concrete Institute (ACI)

- ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures
- ACI 440R-07, Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures
- ACI 440 R-96, State-of-the-Art Report on Fiber Reinforced Plastic (FRP) Reinforcement for Concrete Structures.
- ACI 503 R, Pull-off test to determine FRP adhesion to concrete substrate.
- ACI 562, Code Requirements for Assessment, Repair and Rehabilitation of Existing Concrete Structures.

- ## 2. International Concrete Repair Institute (ICRI)

- a. ICRI Guideline No. 03742, Guide for the Selection of Strengthening Systems for Concrete Structures
- b. ICRI Guideline No. 03739, Guide to Using In-Situ Tensile Pull-Off Tests to Evaluate Bond of Concrete Surface Materials

3. Sika CarboDur Composite Strengthening Systems
 - a. Engineering Guidelines for Design and Application
 - b. Sika CarboDur Calculation Software
4. American Society of Testing and Materials (ASTM)
 - a. ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings using Portable Adhesion Testers

1.5 Quality Control

- A. Quality Control procedures performed by the Manufacturer shall include, but not be limited to the following:
 1. Manufacturer shall have a nationally recognized program of contractor training, certification and technical support.
 2. The Manufacturer shall have minimum ten years experience in FRP Reinforcement confirmed by actual field tests of minimum 500 successful installations.
 3. The Manufacturer shall be able to supply testing data to demonstrate system properties and durability of the actual FRP Reinforcement to be used.
- B. Quality Control procedures performed by the Contractor shall include, but not be limited to the following:
 1. The Contractor shall be trained by the Manufacturer and shall have completed a program of instruction in the use of FRP Reinforcement.
 2. The Contractor shall have a minimum of two years experience in FRP Reinforcement confirmed by actual field tests of at least 5 successful installations.
 3. The Contractor shall inspect all materials prior to application to assure that they meet specifications and have arrived to the job-site undamaged.
 4. The FRP Reinforcement shall be completely inspected by the contractor during and immediately following application of the composite materials. Conformance with the design drawings, proper alignment of fibers and quality workmanship shall be assured. Entrapped air shall be released or rolled out before the epoxy sets. Defects shall be noted in the Daily Construction Log.
 5. After FRP Reinforcement has cured, the contractor shall inspect the all work to check for voids and or debonding. Repairs shall be made as per Par.3.7 Repair of Defects, and noted in the Daily Construction Log.
 - 6.

1.6 Submittals

- A. Submit for record Material Safety Data Sheets (MSDS) of each product, used on site.
- B. Submit product data indicating product standards, physical and chemical characteristics, environmental durability, technical specifications, limitations, installation instructions, and general recommendations regarding each material.
- C. Submit for record, a qualification statement by the Contractor listing their completed FRP Reinforcement projects, including size, location, owner, engineer/architect and contact numbers.
- D. Submit for record a complete description of the FRP Reinforcing system materials, surface preparation, application procedures, application rates, and cure times.
- E. Submit for record copies of purchase order and packaging slips showing quantities and dates of primer and resin purchased.
- F. Submit for review and approval shop drawings including, the following:
 - 1. Limits of FRP Reinforcing.
 - 2. Details of epoxy injection crack repair and epoxy resin patching.
 - 3. Complete system details including, but not limited to, FRP Reinforcement, primer, resin, and protective coating.
- G. Submit for record test results of the Pull-off test to determine FRP adhesion to concrete substrate.
- H. Submit for record Daily Construction Logs kept by the Contractor. These logs shall include the following information: Weather and temperature at application times; Amount of product used and square footage/linear footage of substrate covered; Batch numbers of all products used; Names of all crew members; Any bond-strength tests, noting location, quantity and who performed these tests.
- I. Submit an approved ICC Evaluation Report in the name of the proposed FRP system to be used on this project.
- J. Submit independent test report verifying the environmental durability of the proposed system to be used on this project. Such reports shall include as a minimum:
 - 1. 10,000 hr. resistance to salt water
 - 2. 10,000 hr. resistance to high temperature (38C) and high humidity (100%)
 - 3. 10,000 hr. resistance to alkali solution (pH 9.5)
 - 4. 3,000 hr. resistance to dry heat (60C)
 - 5. resistance to 20 freeze/thaw cycles
 - 6. resistance to UV/condensation @ 100 cycles

7.resistance to diesel fuel (4 hr. exposure)

1.7 Job-Site Conditions

- A. Do not apply FRP Reinforcement materials if raining, snowing, or dew condensation is expected or existing concrete surface is wet or if the ambient or surface temperature are below 40° F (4°C).
- B. The ambient temperature and temperature of the epoxy components shall be between 50° F (10°C) and 80° F (27°C) at the time of mixing. See appropriate technical data sheets for more specific instructions.
- C. Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.
- D. The Contractor is solely responsible for fume control and shall take necessary precautions against injury to Installer personnel or adjacent building occupants during application of primer and resin, etc. Contractor personnel shall use protective equipment and area shall be well vented to the outside. As a minimum, Installer must take the following precautions:
 - 1. Contractor to locate and protect building air intake during application.
 - 2. Contractor to follow all state, federal, and local safety regulations.
 - 3. Contractor to follow all Manufacturers' safety requirements as indicated on appropriate SDS sheets.

1.8 Delivery, Storage, and Handling

- A. Deliver primer, saturant and protective coating in original, unopened containers with the Manufacturer's name, labels, product identification, and batch numbers.
- B. FRP Reinforcement shall be stored in a cool dry area away from direct sunlight, flame, moisture, or other hazards.
- C. Store primer, saturant and protective coating under conditions as recommended by the Manufacturer in a cool dry place out of direct sunlight. Products that have exceeded their shelf life shall not be used.
- D. Contractor is required to confirm that all materials used in accordance with this Section conform to local, state, and federal environmental and worker's safety laws and regulations.
- E. During operations Contractor shall maintain barricades.
- F. The Contractor shall properly dispose of empty containers in accordance with local regulations.

PART 2 - PRODUCTS

2.1 FRP Reinforcement Fabric and/or Laminate

- A. FRP Reinforcement fabric shall be high strength, high modulus, fiber fabric that may be unidirectional or woven (in various fiber architectures) to suit specific repair needs.

1.FRP Reinforcement fabric shall be of the type, size, layer and location as indicated on the Drawings.

2.FRP Reinforcement fabric shall meet the following minimum requirements:

	SikaWrap Hex 100G	SikaWrap Hex 103C	
Property	Requirement	Requirement	ASTM Test Method
Laminate Tensile Strength	78.4 ksi	160.9 ksi	D3039
Laminate Tensile Strength , In primary fiber direction – 1 layer, per inch width	3.1 kips/in./ply	6.4 kips/in./ply	D7565
Laminate Tensile Modulus , In primary fiber direction	3.97 msi	10.39	D3039
Laminate Elongation at break	1.82%	1.45%	D3039
Dry Fabric Weight , Minimum, per square yard	27 oz./yd ² (917 g/m ²)	18 oz./yd ² (611 g/m ²)	
Percent Laminate Tensile Strength Retained after: 7 days, 100% humidity, 100°F (38°C) 3,000 hrs exposure to alkali 3,000 hrs exposure to salt water 3,000 hrs exposure at 140°F (60°C)	90% 90% 90% 90%	90% 90% 90% 90%	
Visual Defects	✓	✓	D2563

	SikaWrap Hex 103C HM	SikaWrap Hex 103C-2X	
Property	Requirement	Requirement	ASTM Test Method
Laminate Tensile Strength	152.0 ksi	160.1 ksi	D3039
Laminate Tensile Strength , In primary fiber direction – 1 layer, per	6.1 kips/in./ply	11.2 kips/in./ply	D7565

inch width			
Laminate Tensile Modulus , In primary fiber direction	13.5 msi	12.3 msi	D3039
Laminate Elongation at break	1.05%	1.15%	D3039
Dry Fabric Weight , Minimum, per square yard	18 oz./yd ² (611 g/m ²)	37.2 oz./yd ² (1,262 g/m ²)	

3. Approved products are:

- a. SikaWrap Hex Fabrics (100G, 106G, 103C, 103C HM, 103C-2X, 113C, 117C, 230C, 600C +/-45), Sika Corp, Lyndhurst, NJ.
- b. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

B. FRP Precured Strip shall be high strength, high modulus, unidirectional carbon fiber reinforced polymer (CFRP).

1. FRP Precured Strip shall be of the type, size, layer and location as indicated on the Drawings.

2. FRP Precured Strip, shall meet the following minimum requirements:

	Sika CarboDur Strip	
Property	Requirement	ASTM Test Method
Laminate Tensile Strength , In primary fiber direction	406,000 psi (2,800 MPa)	D3039
Laminate Tensile Modulus , In primary fiber direction	23.2x10 ⁶ psi (160,000 MPa)	D3039
Laminate Elongation at break	1.69 %	D3039
Laminate Thickness	0.047 in. (1.2mm)	
Fiber Volume , minimum	68%	D2563

3. Approved products are:

- A. Sika CarboDur, Sika Corp., Lyndhurst, NJ.
- B. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

C. FRP Precured Rods shall be high strength, high modulus, unidirectional carbon fiber reinforced polymer (CFRP)

1. FRP Precured Rods shall be of the type, size, layer and location as indicated on the Drawings.

2.FRP Precured Rods, shall meet the following minimum requirements:

	Sika CarboDur Rods	
Property	Requirement	ASTM Test Method
Laminate Tensile Strength , In primary fiber direction	406,000 psi (2,800 MPa)	D3039
Laminate Tensile Modulus , In primary fiber direction	22.5x10 ⁶ psi (155,000 MPa)	D3039
Laminate Elongation at break	1.89 %	D3039
Fiber Volume , minimum	65%	D2563

3. Approved products are:

D. Sika CarboDur Rods, Sika Corp., Lyndhurst, NJ.

E. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

2.2 Concrete Surface Primer

A. Surface Primer shall be a two component, 100% solids, moisture/tolerant, high modulus, high strength epoxy.

B. Surface Primer shall meet the following minimum requirements:

	Sikadur 330	
Property	Requirement	ASTM Test Method
Tensile Strength	4,900 psi	D638
Elongation at Break	1.2%	D638
Flexural Strength	8,800 psi	D790
Flexural Modulus	506,000 psi	D790
Heat Deflection Temp. (HDT)	120F (48C)	D648

C. Approved products are:

1. Sikadur 330, Sika Corp., Lyndhurst, NJ.

2. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

2.3 Fabric Saturant

- A. Saturant resin shall be two component, 100% solids, moisture tolerant, high strength, high modulus epoxy.
- B. Saturants shall meet the following minimum requirements:

	Sikadur (Hex) 300	
Property	Requirement	ASTM Test Method
Tensile Strength	7,500 psi	D638
Tensile Modulus	280,000 psi	D638
Elongation at Break	3.2%	D638
Flexural Strength	11,500 psi	D790
Flexural Modulus	510,000 psi	D790
Heat Deflection Temp. (HDT)	112 F	D648

- C. Approved products are:
1. Sikadur 300, Sika Corp, Lyndhurst, NJ.
 2. Sikadur Hex 300, Sika Corp, Lyndhurst, NJ.
 3. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

2.4 Epoxy Repair Mortar

- A. Repair mortar shall be 100% solids, non-sag paste epoxy.
- B. Approved products are:
1. Sikadur 30, Sika Corp., Lyndhurst, NJ.
 2. Sikadur 31, Sika Corp., Lyndhurst, NJ
 3. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

2.5 Protective Coating

- A. Protective coating shall be polymer or acrylic based and shall be UV resistant.
- B. Approved products are:
1. Sikagard 550W, Sika Corp., Lyndhurst, NJ.
 2. Sikagard 670W, Sika Corp., Lyndhurst, NJ.

3. Alternate products must be submitted **and** approved by the Engineer a minimum of two weeks prior to the bid date.

PART 3 - EXECUTION

3.1 General

- A. Inspect surfaces to receive the work and report immediately in writing to the Engineer as required in the General Conditions and deficiencies in the surface that render it unsuitable for proper execution of this work.
- B. Protect vehicles, concrete, and other items surrounding work area from dust or damage due to Work of this Section.

3.2 Surface Preparation

- A. All concrete surfaces shall be dry and free of surface moisture and frost, and tested by the Contractor to evaluate moisture transmission in accordance with ASTM D4263 "Indicating Moisture in Concrete by the Plastic Sheet Method."
- B. All concrete surfaces shall be sound. Remove all deteriorated concrete, dust, laitance, grease, paint, curing compounds, waxes, impregnations, foreign particles, and other bond inhibiting materials from the surface by blast cleaning or equivalent mechanical means.
- C. All concrete surfaces shall be air blasted and vacuumed clean to a dust free condition.
- D. Concrete surface irregularities less than one inch shall be ground and smoothed and/or filled with an approved repair mortar (e.g., Sikadur 30) with the addition of 1 part oven dried sand to make an epoxy mortar. Surface irregularities shall be limited to less than 0.04 inches. Surface irregularities greater than one inch shall be repaired using an approved cementitious repair mortar like Sika Top 123. Any sharp edges (e.g. fins, form lines, etc.) must be ground smooth and flush.
- E. Surface levelness (CarboDur strips) – maximum allowable deviation in 6 ft. shall be limited to 1/4 in. (6 mm), but no greater than 1/8 in. per linear ft. (305 mm).
- F. External concrete corners shall be rounded to at least a 1/2" radius when perpendicular to fiber orientation and internal corners shall be smoothed by troweling epoxy mortar into the corners.
- G. The concrete surface should be prepared to a minimum concrete surface profile (CSP) 3 as defined by the ICRI surface profile chips.
- H. The adhesive strength of the concrete shall be verified after preparation by random pull-off testing (ACI 503R or ASTM D4541) at the direction of the Engineer.

Minimum tensile strength is 200 psi with concrete substrate failure, or as approved by the Engineer.

3.3 Mixing Primer and Saturant

- A. Mix components in accordance with Manufacturer's recommendations.
- B. Diluting is not permitted. Pre-condition materials as indicated on technical data sheet.
- C. Mix only that quantity which can be used within its pot life.
- D. Do not batch delivered units into smaller quantities. Mix only full units.

3.4 Primer Application

- A. Apply primer in strictly accordance with Manufacturer's recommendations.
- B. Primer may be applied with a brush or roller. Apply second coat as necessary after first coat has penetrated into the concrete.
- C. Surface depressions shall be filled with epoxy filler as per manufacturers' instructions.
- D. Primer must be covered with fiber within 24 hours of application, depending on temperature conditions. If 24-hour window is exceeded, the primed surfaces must be solvent wiped with a fast flashing solvent (e.g. MEK) or roughened with sandpaper to break the amine blush.

3.5 FRP Reinforcement Application

Method 1: Wet Lay-Up

- A. Apply FRP Reinforcement in accordance with Manufacturer's recommendations.
- B. When using saturator equipment, follow Manufacturer's procedures for proper machine set-up and calibration. Rollers shall be calibrated to saturate the fabric with the proper resin-to-fabric ratio. The roller gap shall be checked daily by a qualified technician for accuracy. The resin-to-fabric ratio shall also be verified by resin usage and documented on the daily project logs.
- C. Once the fabric is saturated, it may then either be spooled for easy handling, or cut to specified lengths and booked for handling. Care must be taken not to damage the fibers.

- D. The fabric may then be applied to the surface with no delay. Work from one end to the other, taking care to orient the fibers as specified. Remove any air entrapped in the fabric with a ribbed roller or squeegee.
- E. Sheets shall be lapped in the longitudinal direction 6 inches minimum or as indicated on the Drawings. Note: no lapping is required of the sheets parallel to the direction of fiber orientation.

Method 2: Dry Lay-Up

- A. Apply FRP Reinforcement in accordance with Manufacturer's recommendations.
- B. FRP Reinforcement sheets shall be cut beforehand into prescribed lengths. Sheets shall be lapped in the longitudinal direction 6 inches minimum or as indicated on the Drawings. Note: no lapping is required of the sheets parallel to the direction of fiber orientation.
- C. Follow Manufacturer's recommendations regarding primer open times.
- D. Apply a primary saturant coat uniformly by roller brush.
- E. Apply FRP Reinforcement sheets fiber side down to the concrete over the fresh saturant using a ribbed roller to remove any air bubbles.
- E. FRP Reinforcement sheets shall be left alone for about 30 minutes allowing for the primary saturant to soak through the fabric. Correct any dislocation on lifting.
- G. Apply secondary saturant coat with roller over installed sheets in order to impregnate and replenish primary saturant.
- H. If succeeding FRP Reinforcement sheets are specified on the Drawings repeat application procedures.

Method 3: Precured Strip Application

- A. Apply FRP Precured Strip in accordance with Manufacturer's recommendations.
- B. Care shall be taken not to damage the fibers in handling and unpacking the Strips.
- C. Strips may be either delivered to project site in factory pre-cut lengths, or cut on site. Care must be taken not to fray or otherwise damage the fibers when field cutting. Follow Manufacturer's recommendations for field cutting of strips.
- D. Strips shall be cleaned with a fast flashing solvent (e.g. MEK) to remove any bond inhibiting materials. A clean white cotton rag shall be used for this purpose. Continue

cleaning the Strip in this manner until no black residue shows on the rag. Cleaning shall be performed the same day the strips are to be used.

Method 4: Precured Rods Application, Near Surface Mounted (NSM)

- A. Apply FRP Precured Rods strictly in accordance with Manufacturer's recommendations.
- B. Care shall be taken not to damage the fibers in handling and unpacking the rods.
- C. Rods may be either delivered to project site in factory pre-cut lengths, or cut on site. Care must be taken not to fray or otherwise damage the fibers when field cutting. Strictly follow Manufacturer's recommendations for field cutting of rods.
- D. Rods can be sanded with medium grit sandpaper to create roughened finish if necessary per job specifications.
- E. Rods shall be cleaned with a fast flashing solvent (e.g. MEK) to remove any bond inhibiting materials. A clean white cotton rag shall be used for this purpose. Continue cleaning the rods in this manner until no black residue shows on the rag. Cleaning shall be performed the same day the rods are to be used.

3.6 Curing

- A. Protect finished installation of FRP Reinforcement from rain, sand, dust, etc. using protective sheeting or other barriers. Do not allow protective sheeting to come in contact with finished application.
- B. Curing of finished application shall be a minimum of 24 hours and in order to achieve full strength curing shall be extended for a period of two weeks at an average ambient temperature of 68°F.

3.7 Repair of Defects

- A. Upon completion of the curing process, the installed system shall be checked for areas where saturant has not penetrated or where saturant has not completely cured. Such areas shall be epoxy injected to re-establish bond subject to the approval of the Project Engineer.
- B. Repair procedures shall be performed in accordance with guidelines established by ACI 440.2R-08 (paragraph 7.2.3) and approved by the Project Engineer. All repairs

shall be subject to the same application, curing and quality control specifications as the original work.

1. Small delaminations and voids less than 2 in² each are permissible as long as the delaminated area is less than 5% of the total laminate area and there are no more than 10 such delaminations per 10 ft².
2. Medium sized delaminations and voids greater than 2 in² but less than 25 in² may be repaired by epoxy resin injection or ply replacement, depending on the size and number of delaminations and their location. The repair procedure should be determined by the Project Engineer.
3. Larger size delaminations and voids greater than 25 in² should be repaired by selectively cutting away the affected sheet and applying an overlapping sheet patch of equivalent plies. The overlap should extend a minimum of 6 in. in all directions.

3.8 Protective Coating

- A. Apply the protective coating strictly in accordance with Manufacturer's recommendations.

3.9 Cleaning

- A. Uncured saturants may be cleaned from tools with an approved solvent and properly disposed.
- B. Cured saturants shall be removed by mechanical means and properly disposed.

END OF SECTION

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes hydraulic-cement-based underlayment for use below interior floor coverings.
- B. Related Sections include the following:
 - 1. Division 09 Sections for patching and leveling compounds applied with floor coverings.
- C. Unit Prices: Administrative and procedural requirements for unit prices are specified in Division 01 Section "Unit Prices."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.
- C. Manufacturer Certificates: Signed by manufacturers of both underlayment and floor covering system certifying that products are compatible.
- D. Qualification Data: For Installer.
- E. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.
- B. Product Compatibility: Manufacturers of both underlayment and floor covering system certify in writing that products are compatible.
- C. Mockups: Apply hydraulic-cement-based underlayment mockups to demonstrate surface finish, bonding, texture, tolerances, and standard of workmanship.

1. Apply mockups approximately 100 sq. ft. (9 sq. m) in area in location indicated or, if not indicated, as directed by Architect.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature and humidity, ventilation, and other conditions affecting underlayment performance.

1.7 COORDINATION

- A. Coordinate application of underlayment with requirements of floor covering products, including adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 HYDRAULIC-CEMENT-BASED UNDERLAYMENTS

- A. Underlayment: Hydraulic-cement-based, polymer-modified, self-leveling product that can be applied in minimum uniform thicknesses of 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Ardex; **K-15 Self-Leveling Underlayment Concrete.**
 - b. Bonsal, W. R. Company; **Self-Leveling Underlayment.**
 - c. ChemRex; **MBT Mastertop 110 Plus Underlayment, Sonneborn Sonocrete Sonoflow, Thoro Underlayment, Self-Leveling.**
 - d. Conspec, a Dayton Superior Company; **Conflow.**
 - e. Dayton Superior Corporation; **Levelayer I.**
 - f. MAPEI Corporation; **Ultraplan 1.**
 3. Cement Binder: ASTM C 150, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
 4. Compressive Strength: Not less than 4100 psi (28 MPa).

5. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer formulated for use with underlayment when applied to substrate and conditions indicated.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm); or coarse sand as recommended by underlayment manufacturer.
 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).
- D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.
- E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance.
 1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
 1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/100 sq. m)**.
- C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 APPLICATION

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
 - 2. Coordinate application of components to provide optimum underlayment-to-substrate and intercoat adhesion.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
 - 1. Apply a final layer without aggregate to produce surface.
 - 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 04100 - MASONRY MORTAR

1. RELATED DOCUMENTS:

The general provisions of the contract, including General and Special Conditions apply to the work specified in this section.

2. DESCRIPTION OF WORK:

The extent of the masonry work is shown on the drawings.

This section specifies the mortar for unit masonry materials specified in section 04220 Concrete Unit Masonry.

3. GENERAL:

Do not change source or brands of masonry mortar materials during the course of the work.

Store mortar materials off the ground, under cover, and in a dry place.

4. MATERIALS:

Portland Cement for Mortar:

Comply with ASTM C 150, Type I, non-staining, without air entrainment and of natural color or white as required to produce the required color of mortar or grout.

Masonry Cement:

Comply with ASTM C 91, Type II non-staining, except with 12% maximum air content by volume.

Hydrated Lime for Mortar: Comply with ASTM C 207, Type S.

Mortar Aggregates: Comply with ASTM C 144.

Water:

Clear and free of deleterious materials which would impair the work.

Setting Bed Sand: Comply with ASTM C 136 with 100% passing the No. 4 sieve.

Additive for Non-Shrink Grout:

Metallic aggregate, prepared and graded to counteract shrinkage and reduce permeability of portland cement grout.

4. MATERIALS (CONT.)

Products offered by manufacturers to comply with the requirements include the following:

Embeco: Master Builder's.
Ferrolith G: Sonneborn.
Irontox: Toch Brothers.
Kemox C: Sitka Chemical.
Vibra-Foil: W.R. Grace.

Commercial Cement Grout:

Proprietary compound of portland cement and additive, factory-blended to decrease shrinkage and increase moisture resistance.

Products offered by manufacturers to comply with the requirements include the following:

Hydroment Joint Filler: The Upco Co.
L & M Acid-R Grout: L & M - Surco Co.

5. MORTAR MIXES:

Mortar for Unit Masonry:

Comply with ASTM C 270 Proportion Specifications, except, limit materials to those specified herein, and limit cement/lime ratio (by volume) as follows:

Type S:

Not more than 1/2 part lime per part of portland cement.

Type N:

Not more than 1 part lime per part of portland cement. In lieu of above, Type II masonry cement may be used.

6. INSTALLATION:

SECTION 04100 - MASONRY MORTAR

See section 04220 "Unit Masonry".

7. SUBMITTALS:

Manufacturer's Data, Masonry Mortar:

Submit 2 copies of manufacturer's specifications and instructions for each manufactured product. Indicate that copy of each applicable instruction has been distributed to the Masonry Installer.

*****END OF SECTION*****

SECTION 04220 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work included: Provide concrete unit masonry where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

- A. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Materials list of items proposed to be provided under this Section;
 - 2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.4 PRODUCT HANDLING

- A. Store masonry units above ground on level platforms which allow air circulation under the stacked units.
- B. Cover and protect against wetting prior to use.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Provide lightweight hollow load-bearing concrete masonry units complying with ASTM C90, grade N, type I, in color "natural gray".
- B. Dimensions:

1. Provide units of the dimensions shown on the Drawings.
 2. Where dimensions are not shown on the Drawings, provide units having nominal face dimensions of 16" long by 8" high by the depth shown or otherwise required.
- C. Provide accessory shapes as indicated or otherwise required.

2.2 REINFORCEMENT AND ACCESSORIES

- A. Comply with the following as minimums.
1. Bars: ASTM A615, grade 60, unless otherwise shown on the Drawings, using deformed bars for number 3 and larger.
 2. Bending: ACI 318.
 3. Wire reinforcement: ASTM A82.
- B. Fabricate reinforcement in accordance with recommendations contained in CRSI "Manual of Standard Practices."

2.3 MORTAR

- A. Ingredients:
1. Portland cement: Comply with ASTM C150, type I.
 2. Lime:
 - a. Provide hydrated lime complying with ASTM C207, or quicklime complying with ASTM C5.
 - b. When quicklime is used, slake and then screen through a 16 mesh sieve. After slaking and screening, but before using, store and protect for not less than ten days.
 3. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter, and complying with ASTM C144.
 4. Admixtures: Do not use admixtures unless specifically approved in

SECTION 04220 - CONCRETE UNIT MASONRY

advance by the Architect.

5. Water: Provide water free from deleterious amounts of acids, alkalis, and organic materials.

B. Mixing:

1. Provide mortar type "M" or type "S", as designated on the Drawings or otherwise directed by the Architect, and in accordance with ASTM C270.
2. Proportions:
 - a. For type "M" mortar, provide one part portland cement to 1/4 part hydrated lime and 3-3/4 parts sand by volume.
 - b. For type "S" mortar, provide one part portland cement to 1/2 part hydrated lime and 4-1/2 parts sand by volume.
3. Mechanically mix in a batch mixer for not less than three minutes, using only sufficient water to produce a mortar which is spreadable and of a workable consistency.
4. Retemper mortar with water as required to maintain high plasticity.
 - a. On mortar boards, retemper only by adding water within a basin formed with mortar, and by working the mortar into the water.
 - b. Discard and do not use mortar which is unused after 1-1/2 hours following initial mixing.

2.4 GROUT

A. Ingredients:

1. Portland cement: Comply with ASTM C150, type I.
2. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter.

SECTION 04220 - CONCRETE UNIT MASONRY

3. Admixtures: Do not use admixtures unless specifically approved in advance by the Architect.
 4. Water: Provide water free from injurious amounts of acids, alkalis, and organic materials.
- B. Mixing:
1. Provide "fine grout" or "coarse grout" as designated on the Drawings or otherwise directed by the Architect, and in accordance with ASTM C476.
 2. When the minimum grout compressive strength is required to be more than 2000 psi, provide laboratory design mix prepared as required for design mixes of concrete under Section 03300 of these Specifications.
 3. Proportions:
 - a. For "fine grout," provide one part portland cement to 2-1/4 parts minimum to 3 parts maximum of damp loose sand, with sufficient water to achieve fluid consistency.
 - b. For "coarse grout," provide one part portland cement to 3 parts maximum of damp loose sand to two parts coarse aggregate, with sufficient water to achieve fluid consistency.
 4. "Fluid consistency" is interpreted as meaning as fluid as possible for pouring intimately in place without segregation.
- C. Use "fine grout" where called for on the Drawings, where the grout space is less than 3" in its least dimension, and where otherwise directed by the Architect or required by governmental agencies having jurisdiction.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion

SECTION 04220 - CONCRETE UNIT MASONRY

of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 ENVIRONMENTAL CONDITIONS

- A. Do not place masonry units when air temperature is below 40 degrees F.
- B. Protect masonry construction from direct exposure to wind and sun when erected in ambient air temperature of 99 degrees F in the shade, with relative humidity less than 50%.

3.3 INSTALLATION

A. General

- 1. Do not commence installation of the work of this Section until horizontal and vertical alignment of foundation is within 1" of plumb and the lines shown on the Drawings.
- 2. Lay only dry masonry units.
- 3. Use masonry saws to cut and fit masonry units.
- 4. Set units plumb, true to line, and with level courses accurately spaced.
- 5. Clean the top surface of foundation free from dirt, debris, and laitance, and expose the aggregate prior to start of installing first course.
- 6. Accurately fit the units to plumbing, ducts, openings, and other interfaces, neatly patching all holes.
- 7. Keep the walls continually clean, preventing grout and mortar stains. If grout does run over, clean immediately.

B. Unless otherwise shown on the Drawings, provide running bond with vertical joints located at center of masonry units in the alternate course below.

C. Do not use chipped or broken units. If such units are discovered in the finished wall, the Arc

D. Laying up:

SECTION 04220 - CONCRETE UNIT MASONRY

1. Place units in mortar with full shoved bed and head joints.
2. Align vertical cells of hollow units to maintain a clear and unobstructed system of flues.
3. Hold racking to an absolute minimum.
4. Provide cleanouts at the bottom of each cell of hollow units for removing mortar dropping. Do not close the cleanouts until they have been inspected and approved by the Architect.

E. Reinforcement:

1. Provide reinforcement as shown on the Drawings, fully embedded in grout and not in mortar or mortar joints.
2. Provide required metal accessories to ensure adequate alignment of steel during grout filling operations.

F. Tooling:

1. Tool joints to a dense, smooth surface.
2. Consolidate grout at time of pour by puddling with a mechanical vibrator, filling all cells of the masonry, and then reconsolidating later by puddling before the plasticity is lost.

3.5 CLEANING

A. Inspection and adjustment:

1. Upon completion of the work of this Section, make a thorough inspection of installed masonry and verify that units have been installed in accordance with the provisions of this Section.
2. Make necessary adjustments.

B. Clean surfaces of masonry as required for proper application of the specified finishes.

END OF SECTION

1.0 SCOPE

Includes furnishing and installing all structural and miscellaneous steel as shown on drawings and specified including, but not necessarily limited to, the following major items:

Structural Steel Elements

Anchor Bolts

2.0 APPLICABLE PUBLICATIONS AND STANDARDS

The latest edition and addenda of the applicable standards, on the date of contract Award are part of this Specification. Where this specification appears to conflict with the requirements of referenced document, such conflict shall be brought to the attention of owner for resolution.

3.0 GENERAL

- 3.1 The current rules and practices set forth in the Code of Standard Practice for Steel Buildings and Bridges, and the Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction, shall govern this work, except as otherwise noted on the drawings or as otherwise specified. Welding shall be in accordance with the Standard Codes for Arc and Gas Welding in Building Construction of the American Welding Society.
- 3.2 Joints, where indicated on drawings, shall be assembled by use of high tensile steel bolts in accordance with Specifications Approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
- 3.3 Shop drawings shall be submitted for approval. Material fabricated or delivered to the Contractor shall be subject to rejection.

- 3.4 The Contractor shall furnish, without extra cost to owner, two certified copies of all mill reports covering the chemical and physical properties of the steel used in the work under this Specification.
 - 3.5 Substitutions of sections or modifications of details, or both, shall be made only when warranted and approved by the Owner's Engineer.
 - 3.6 The Contractor alone shall be responsible for all errors of fabrication and for the correct fitting of the structural members shown on the shop drawings.
 - 3.7 Templates shall be furnished as shown on the drawings. The Contractor shall furnish instructions for the setting of anchors and bearing plates and shall ascertain that the items are set during the progress of the work.
- 4.0 MATERIALS:
- 4.1 Structural Steel:
 - a. Major Structural steel items such as Columns, beams, trusses, etc., shall conform to ASTM A-36 in weights and sizes indicated on drawings, unless otherwise approved by Structural Engineer.
 - b. Stock materials such as angles, bars, plates, etc. shall be of quality as specified under (1) above.
 - 4.2 Arc-Welding Electrodes:

Arc-Welding electrodes shall conform to the "Specifications for Iron and Steel Arc-Welding Electrodes" of the American Welding Society.
 - 4.3 Anchor Bolts:
 - a. Anchor bolts shall comply with the requirements of A-325 Steel.
 - b. Anchor bolts shall be maintained free from any deformation, and free from loose rust, loose scale, oil, and, any, other deleterious substances. Contractor shall grease the threads at the projection ends of the anchor bolts, and shall provide such other protection as may be required to maintain the anchor bolts in proper condition until their incorporation into the work.

- c. Contractor shall provide all templates and devices necessary for the accurate positioning and setting of all embedded items specified herein of in other sections of the specifications, and/or indicated on the Contract Drawings.
- d. Anchor bolts shall be pretensioned to minimum yield point specified for steel conforming to ASTM A-325. Anchor bolts shall be pretensioned by turn-of-nut tightening in accordance with the applicable provisions of the ACRBSJ Specifications or, by a jacking method approved by owner. When the turn-of-nut method is used, anchor bolts shall be pretensioned by tightening and additional two-thirds turn-of-nut after an initial tightening to the "snug tight Position".

4.4 Bolt Installation:

- a. Bolts shall be installed in accordance with the RCBSJ Specification. When the turn-of-nut method is used, the snug-tight position of each bolt shall be marked on the member and on the turned part; bolts over-tightened shall be replaced. When direct tension indicators are used, bolts tightened to the extent that the gap is completely closed shall be replaced. Rejected bolts shall not be re-used.
- b. Holes in parts to be connected shall be judged as out of alignment when the specified fastener, hand-held, cannot be passed through the pieces to be joined. Holes out of alignment may be enlarged within the limitations for minimum edge distance and spacing specified in the AISC Steel Specifications. A larger fastener shall be used in holes that are enlarged to correct misalignment, and, tolerances on hole sizes in each of the pieces to be joined shall conform to AISC Steel Specification requirements for the larger fastener.
- c. Rusted bolts shall not be installed.

5.0 INSPECTION AND TESTS:

The material to be furnished under this specification shall be subject to inspection and tests in the mill, shop and field. Inspection and tests will be conducted without expense to the Contractor however, inspection in the mill or shop shall not relieve the Contractor of his responsibility to furnish satisfactory materials and the Owner's Engineer reserves the right to reject any materials at any time before final acceptance of the structure, when

in his opinion the materials and workmanship do not conform to the specifications requirements.

6.0 DESIGN:

The design of members and connections for any portions of the structure not indicated on the contract drawings shall be completed by the fabricator. Such design shall conform to the requirements of the current issue of the Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction. Drawings showing such designs shall be comparable in extent of information and detail to those issued for bidding. The design drawings shall be submitted for approval before any material is fabricated. Subsequent to approval, no changes or modifications shall be made without written authorization.

7.0 WORKMANSHIP:

7.1 Connections shall be as shown on the drawings. When details are not shown, the connections shall conform to the requirements for AISC standard connections. One-side or other types of eccentric connections will not be permitted unless shown in detail on the drawings. Where so indicated in drawings, connections shall be made by use of high tensile steel, bolts, nuts and washers in accordance with the requirements of the specifications approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

- a. Unless otherwise indicated on drawings, field connections shall be in accordance with the requirements of the AISC Specifications. No combination of rivets and bolts or welds shall be used in the same face of any connection.
- b. Welded connections will be permitted only as indicated on the drawings or as specifically authorized in writing.

7.2 Holes shall not be made or elongated by burning, nor will the burning of unfair holes in the shop or field be acceptable. Holes shall be provided in members to permit connection the work of other trades who will furnish the necessary templates or such information as may be required.

7.3 Camber shall conform to the AISC Specifications unless otherwise noted on Drawings or authorized.

- 7.4 Nuts shall be of an approved self-locking type, or the bolt threads shall be upset to prevent backing off of the nuts.

8.0 ERECTION:

Drift pins may be used only to bring together the several parts they shall not be used in such manner as to distort or damage the metal.

- 8.2 The use of a gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major members in the structural framing. Its use will be permitted on minor members when the member is not under stress, and then only after written approval has been obtained.

- 8.3 Field Bolts in work which will be exposed to the weather upon completion shall be dipped in red lead paint just before they are put in place.

9.0 SAFETY PRECAUTION:

In addition to the applicable provisions of the Puerto Rico Occupational Safety and Health Administration Safety Manual, the following requirements shall be met:

All steel shall be securely anchored before falls are cut loose.

END OF SECTION

1. GENERAL

1.1 Description

- 1.1.1 Work included: Furnish; fabricate; mark for erection identification; pack, crate, or otherwise properly prepare for shipment; and ship to the site all structural steel indicated on the Drawings, specified herein, and/or needed for proper completion of the Work.

1.2 Quality Assurance

- 1.2.1 Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- 1.2.2 Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedures."

1.3 Submittals

- 1.3.1 Product data: Within 45 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

Producers' or manufacturers' specifications and installation recommendations for the following products, including laboratory test reports and other data required to prove compliance with the specified requirements.

- a. Structural steel, including certified copies of mill test reports covering chemical and physical properties.
- b. High strength bolts, including nuts and washers.
- c. Unfinished bolts and nuts.

- d. Structural steel primer paint.

Shop Drawings including complete details and schedules for fabrication and shop assembly of members.

- a. Include details of cuts, connections, camber, holes, and other pertinent data.
- b. Indicate welds by AWS symbols, and show size, type, and length of weld.
- c. Provide setting drawings, templates, and directions for installing anchor bolts and other required anchors.
- d. Identify details by reference to sheet and detail number of the Drawings.

1.4 Product Handling

- 1.4.1 Delivery, storage, and handling - Deliver materials to the job site properly marked to identify the location for which they are intended. Use markings corresponding to markings shown on the approved Shop Drawings. Store in a manner to maintain identification and to prevent damage.

2. PRODUCTS:

2.1 Materials

- 2.1.1 Rolled steel plates and bars: Comply with ASTM A36.
- 2.1.2 Steel pipe: Comply with ASTM A53, type E or S, grade B and, where applicable, API-5L, grade B.
- 2.1.3 Steel tube: Comply with ASTM A501.
- 2.1.4 Anchor bolts: Comply with ASTM A307, non-headed type with heavy hexagonal nuts unless otherwise indicated.
- 2.1.5 Unfinished threaded fasteners:

- a. Comply with ASTM A307, grade A, regular low carbon steel bolts and nuts.
- b. Provide either hexagonal or square heads and nuts; except use only hexagonal units for exposed connections.

2.1.6 High strength threaded fasteners: Provide heavy hexagonal structural bolts, heavy hexagonal nuts, and hardened washers, all from quenched and tempered medium carbon steel complying with ASTM A325, unless otherwise specified on drawings.

2.1.7 Electrodes for welding: Comply with AWS Code, using AWS A5.1 or A5.5 E70XX electrodes.

2.2 Fabrication

2.2.1 Shop fabrication and assembly:

- a. Fabricate items of structural steel in accordance with AISC specifications, and as indicated on the approved Shop Drawings.
- b. Properly mark and match-mark materials for field assembly and for identification as to location for which intended.
- c. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
- d. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations.
- e. Provide finish surfaces of members exposed in the final structure free from markings, burrs, and other defects.

2.2.2 Connections:

- a. Provide bolts and washers of types and sizes required for completion of field erection.
- b. High strength bolted construction:

- (1) Install high strength threaded fasteners in
05118-3

accordance with ASIC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts."

(2) Use A325N bolts unless noted otherwise.

- c. Welded construction: Comply with AWS Code for procedures, appearance, and quality of welds, and methods used in correcting welded work.
- d. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.2.3 Holes for other work:

- a. Provide holes required for securing other work to structural steel framing, and for passage of other work through steel framing members, as shown on the approved shop drawings.
- b. Provide threaded nuts welded to framing, and other specialty items as shown, to receive other work.
- c. Cut, drill, or punch holes perpendicular to metal surfaces.
- d. Do not flame cut holes or enlarge holes by burning.
- e. Drill holes in bearing plates.

2.3 Shop Painting

2.3.1 General:

- a. Shop paint structural steel work, except those members or portions of members to be embedded in concrete or mortar.
- b. Paint embedded steel which is partially exposed on the exposed portions, and the initial 2" of embedded areas only.
- c. Do not paint surfaces which are to be welded or high-strength bolted with friction type connections.

- d. Apply two coats of paint to surfaces which are inaccessible after assembly or erection. Change color of the second coat to distinguish it from the first.

2.3.2 Surface Preparation:

- a. After inspection and before shipping, clean steelwork to be painted.
- b. Remove loose rust, loose mill scale, and splatter, slag, and flux deposits.
- c. Clean steel in accordance with Steel Structures Painting Council SP-3, "Power Tool Cleaning."

2.3.3 Painting:

- a. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's recommendations and at a rate to provide a uniform dry film thickness.
- b. Use painting methods which will result in full coverage of joints, corners, edges, and exposed surfaces.

3. EXECUTION

3.1 Fabrication:

- 3.1.1 Comply with AISC specifications and "Code of Standard Practice", except as may be modified herein.

3.1.2 Anchor bolts:

- a. Provide anchor bolts and other connectors required for securing structural steel to foundations and other place work.
- b. Provide templates and other devices necessary for presetting bolts and anchors to accurate locations.

3.1.3 Bases and bearing plates: Shop weld to columns and members attached to concrete.

3.1.4 Splicing:

- a. Splice members only where indicated unless, with the Architect's approval, splices not indicated would result in lower costs due to reduced shipping expense.
- b. For splices not indicated, submit structural calculations prepared and signed by a structural engineer licensed to practice where the fabricator is located.

3.1.5 Gas cutting:

- a. Do not use gas cutting torches for correcting fabricating errors in the structural framing.
- b. Cutting will be permitted only in secondary members as acceptable to the Architect.
- c. When gas cutting is permitted, finish the gas cut section to a sheared appearance acceptable to the Architect.

3.2 TESTING AND INSPECTING

3.2.1 Test costs:

- a. The Owner's selected testing laboratory will pick up specimens and make required tests.
- b. Cost of procuring test specimens at locations more than 50 miles from the job site will be paid by the Contractor.
- c. Costs of tests of identified stock will be paid by the Contractor.
- d. Costs of tests of unidentified stock will be paid by the Contractor.

3.2.2 Test specimens:

- a. Test specimens shall be furnished by the steel fabricator, and shall be taken under the direction of the Owner's selected testing laboratory.
- b. Each specimen shall be machined by the Owner's selected testing laboratory to dimensions required by ASTM A370.
- c. Cost of procuring, making, and machining test specimens shall be considered tests costs as defined above.

3.2.3 Identification and tests:

- a. If structural steel can be identified by heat or melt numbers, and if accompanied by mill analysis and test reports, not less than one tension and one bend test will be made for each ten tons or fractional part thereof.
- b. If structural steel cannot be identified, or if its source is questionable, not less than one tension test and one bend test will be made for each five tons or fractional part thereof.
- c. If steel pipe can be identified by heat or melt numbers, or manufacturer's name, not less than one tension test and one bend test will be made for each ten tons or fractional part thereof.
- d. Additional tests may be required when deemed necessary by the Architect or Owner.

3.2.4 Inspecting:

- a. A complete four sided inspection of steel will be made when required by the Architect or Owner.
- b. Cost of inspecting will be paid by the Owner subject to the same provisions made above for tests.
- c. If, after fabrication and inspection, the work of this Section is found to be defective and to require re inspection, cost of

such re inspection will be paid by the Owner and back charged to the Contractor.

- d. Provide labor, equipment, and facilities needed to move and handle the materials to be inspected.

3.2.5 Welding inspection:

- a. Unless otherwise specified, perform welding under observation of a qualified inspector from a laboratory approved by the Architect.
- b. Inspect every layer of weld for quality, penetration, and conformity with design requirements.
- c. Require the welding inspector to submit a signed report to the Architect, verifying that:
 - (1) The welding is adequate and was performed in conformity with the specified requirements; and
 - (2) Adequate methods have been used to determine the quality of the welding.
- d. The welding inspector may use gamma ray, magnaflux, trepanning, or any other aid to visual inspection considered necessary to assure adequacy of welding, or may use ultrasonic testing performed in accordance with pertinent requirements of governmental agencies having jurisdiction.
- e. Cost of welding inspection will be paid by the Contractor.

- 3.2.6 Access: Provide access for the testing agencies and inspectors to places where structural steel work is being fabricated or produced, so that required testing and inspecting may be accomplished.

*** END OF SECTION***

1. GENERAL

1.1 DESCRIPTION

- A. Work included: Erect structural steel shown on the drawings, as specified herein, and as needed for a complete and proper installation.
- B. Definition: Structural steel is that work defined as such in the AISC "Code of Standard Practice", and as otherwise shown on the drawings or specified herein.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedures".
- C. The contractor shall engage and pay for the services of a recognized independent testing laboratory for the purpose of performing inspections and tests as herein specified.

1.3 SUBMITTTALS

- A. Shop Drawings: Should the Contractor elect to change the sequence of erection, or other details of field erection, submit necessary shop drawings to the Architect for review.

1.4 PRODUCT HANDLING

- A. Protection:
 - 1. Store materials to permit easy access for inspection.
 - 2. Keep steel members off the ground, using pallets or other support.

3. Protect steel members and packaged materials from corrosion and deterioration.

2. PRODUCTS:

2.1 MATERIALS

- A. General: Provide other materials required for completion of erected structural steel.
- B. Headed stud type shear connectors: Comply with ASTM A108, grade 1015 or 1020, cold-finished carbon steel, with dimensions complying with the AISC specifications.
- C. Unfinished threaded fasteners:
 1. Comply with ASTM-A307, grade A, regular low carbon steel bolts and nuts.
 2. Provide hexagonal heads and nuts for all connections.

2.2 FABRICATION

- A. High strength bolted construction:
 1. Install high strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".
 2. Use A325N bolts unless otherwise noted.
- B. Welded construction:
 1. Comply with AWS Code for procedures, appearance, and quality of welds, and for methods used in correcting welding.
 2. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

3. EXECUTION

3.1 SURFACE CONDITIONS:

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 ERECTION:

- A. Comply with AISC specifications and "Code of Standard Practice", and as specified herein.
- B. Survey:
 - 1. Establish permanent benchmarks necessary for accurate erection of structural steel.
 - 2. Check elevations of concrete surfaces, and locations of anchor bolts and similar items, before erection proceeds.
- C. Temporary shoring and bracing:
 - 1. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads.
 - 2. Provide temporary guy lines to achieve proper alignment of the structure as erection proceeds.
 - 3. Remove temporary connections and members when permanent member's area in place and the final connections have been made.
- D. Anchor bolts:
 - 1. Install anchor bolts and other connectors required for securing structural steel to foundations and other in place work.
 - 2. Provide templates and other devices needed for presetting bolts and other anchors to accurate locations.
- E. Setting bases and bearing plates:

Clean concrete bearing surfaces free from bond-reducing materials, and then roughen to improve bond to the surface.

Clean the bottom surface of base and bearing plates.

Set loose and attached base plates and bearing plates for structural members in wedges or other adjusting devices.

Tighten anchor bolts after the supported members have been positioned and plumbed.

Do not remove wedges or shims but, if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.

Pack grout solidly between bearing surfaces and bases or plates to assure that no voids remain.

Finish exposed surfaces, protect installed material, and allow to cure in strict compliance with the manufacturer's recommendations as approved by the Architect.

F. Field Assembly:

1. Set structural frames accurately to the lines and elevations indicated.
2. Align and adjust the members forming part of a complete frame or structure before fastening permanently.
3. Clean the bearing surface, and other surfaces which will be in permanent contact, before assembly.
4. Adjust as required to compensate for discrepancies in elevation and alignment.
5. Level and plumb individual members of the structure within specified AISC tolerances.
6. Establish required leveling and plumbing measurements on the mean operating temperature of the structure, making allowances for the difference between temperature at time of erection and the

mean temperature at which the structure will be when completed and in service.

7. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

G Gas cutting:

Do not use gas cutting torches for correcting fabricating errors in the structural framing.

Cutting will be permitted only on secondary members as acceptable to the Architect.

When gas cutting is permitted, finish the section to a sheared appearance acceptable to the Architect.

3.3 FIELD QUALITY CONTROL

A. Inspection:

1. The contractor's testing and inspecting agency will inspect high strength bolted connections, will visually inspect field welded connection, will perform such additional tests and inspection of field work as are required under Section 05118 of these specifications or by the Architect, and will prepare test reports for the Architect's review.
2. The testing agency will conduct and interpret the tests and will state in each report whether the inspected work complies with the requirements, and will specifically state all deviations therefrom.

B. Correction:

1. Correct deficiencies in structural steel work which inspections and test reports indicate to be not in compliance with the specified requirements.
2. Perform additional tests required to conform noncompliance of the original work and to show compliance of corrected work, all at

no additional cost to the Owners.

- C Inspect field bolted connections in accordance with the AISC specifications.
- D Field welding: Inspect and test during erection of structural steel as follows:
 - 1. Certify welders and conduct inspections and tests in accordance with provisions of Paragraph 3.2-E of this section of these specifications.
 - 2. Record types and locations of defects found in the work of this section.
 - 3. Record the work required and performed to correct deficiencies.
 - 4. Perform visual inspection of all welds.

3.4 PAINTING:

- A General: Prime coat structural steel and fittings, except galvanized items, which will not be enclosed or concealed in the finished work.
- B Procedures:
 - 1. After erection, clean spots and surfaces where paint has been removed, damaged, or burned off, and clean field bolts and other field connections not concealed in the finished work.
 - 2. Remove dirt, oil and grease.
 - 3. Apply a spot coat of the approved primer.
 - 4. Do not apply paint to wet, damp, oily, or improperly prepared surfaces.
 - 5. Spray apply the primer, filling joints and corners, and covering surfaces with a smooth unbroken film of at least 1.5 dry mils thickness.
- C Notify the Architect when the work of this section is ready to receive primer.

- D Secure inspection and approval by the Architect prior to application of primer.

END OF SECTION

PART 1 GENERAL

1.011 RELATED DOCUMENTS

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

1.012 SUMMARY

- A.** This Section includes the following:

1. Steel roof deck.
2. Acoustical steel roof deck.
3. Long-span steel roof deck.
4. Long-span cellular steel roof deck.
5. Composite steel floor deck.
6. Composite cellular metal floor deck with electrical distribution.
7. Noncomposite cellular metal floor deck with electrical distribution.
8. Noncomposite steel form deck.
9. Noncomposite vented steel form deck.

- B** Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 3 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.
2. Division 3 Section "Insulating Concrete Decks" for lightweight insulating concrete fill.
3. Division 5 Section "Structural Steel" for shop-welded shear connectors.

- 4 Division 5 Section "Metal Fabrications" for framing openings with miscellaneous steel shapes.
- 5 Division 9 Section "Painting" for touchup and repair painting of deck.
- 6 Division 9 Section "Special Coatings" for touchup and repair of special deck coatings.
- 7 Division 16 Section "Under floor Raceways" for header trenches, duct fittings, preset inserts, service fittings, and outlets used with cellular metal floor deck.

1.13 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 deck, accessory, and product specified.
- C Shop drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, and deck openings, special jointing, accessories, and attachments to other construction.
 - 1. For steel deck indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.
- D Product certificates signed by manufacturers of steel deck certifying that their products comply with specified requirements.
- E Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- F Product test reports from qualified independent testing agencies evidencing compliance with requirements of the following based on comprehensive testing:
 - 1. Mechanical fasteners.
- G Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence steel deck's compliance with the building code in effect for the Project.

1.014 QUALITY ASSURANCE

Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

A. Testing Agency Qualifications: To qualify for acceptance, 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 Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C Fire-Test-Response Characteristics: Where indicated, provide steel deck panels identical to those tested as part of an assembly for fire resistance per ASTM E 119 by a testing and inspection agency performing testing and follow-up services, that is acceptable to authorities having jurisdiction.

1. **Fire-Resistance Ratings:** As indicated by design designations listed in UL "Fire Resistance Directory," or by Warnock Hersey or another testing and inspecting agency.

2. **Labeling:** Identify steel deck with appropriate markings of applicable testing and inspecting agency.

D Electrical Raceway Panels: Provide UL-labeled, cellular metal floor deck panels conforming to UL 209 and listed in UL "Electrical Construction Materials Directory" as approved for use with standard header ducts and outlets for electrical distribution systems.

E FM Listing: Provide steel roof deck evaluated by Factory Mutual and listed in Factory Mutual "Approval Guide" for Class 1 fire rating and Class 1-60 windstorm ratings.

F Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of steel deck similar to this Project in material, design, and extent and that have a record of successful in-service performance.

1.015 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.016 COORDINATION

A. Coordinate installation of sound-absorbing insulation strips in acoustic deck ribs with related units of Work specified in other Sections to ensure that the insulation is protected against damage from effects of the weather and other causes.

B Coordinate installation of trench headers, preset inserts, and duct fittings in cellular metal floor deck with related units of Work specified in other Sections prior to casting concrete slab.

PART 2 PRODUCTS

1.021 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:

B Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Buildings Co.
2. ASC Pacific Inc.

SECTION 05310 – STEEL DECK

DIVISION 5 – METALS

3. Bowman Metal Deck Armco, Inc.
4. Consolidated Systems, Inc.
5. Epic Metals Corp.
6. Marlyn Steel Products, Inc.
7. Robertson A United Dominion Co.
8. Roof Deck, Inc.
9. United Steel Deck, Inc.
10. Verco Manufacturing Co.
11. Vulcraft Div. of Nucor Corp.
12. Walker Div. of Butler Manufacturing Co.
13. Wheeling Corrugating Co., Div. of Wheeling-Pittsburgh Steel Corp.

1.022 ROOF DECK

A. Steel Roof Deck: Fabricate panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:

1. Prime-Painted Steel Sheet: ASTM A 611, Grade C, shop primed as follows:
 - a. Shop Primer: Grey or white baked-on, lead- and chromate-free rust-inhibitive primer, conforming to the performance requirements of Fed. Spec. TT-P-664.
2. Galvanized-Steel Sheet: ASTM A 446, Grade A, G 90 (ASTM A 446M, Grade A, Z 275) zinc coated according to ASTM A 525 (ASTM A 525M).
3. Deck Profile: Type NR, narrow rib.

4. Deck Profile: Type IR, intermediate rib.
5. Deck Profile: Type WR, wide rib.
6. Deck Profile: Type 3DR, deep rib.
7. Profile Depth: 1-1/2 inches (38 mm).
8. Design Uncoated-Steel Thickness: 0.0358 inch (0.91 mm).
9. Span Condition: Triple span or more.
10. Side Joints: Overlapped.
11. Side Joints: Interlocking seam.
12. Side Joints: Overlapped or interlocking seam at Contractor's option.

1.023 FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels with integrally embossed or raised pattern ribs and interlocking side laps, conforming to SDI Publication No. 28 "Specifications and Commentary for Composite Steel Floor Deck," the minimum section properties indicated, and the following:

1. Galvanized-Steel Sheet: ASTM A 446, Grade A, G 60 (ASTM A 446M, Grade A, Z 180) zinc coated according to ASTM A 525 (ASTM A 525M).
2. Galvanized-Steel Sheet: ASTM A 446, Grade A, G 90 (ASTM A 446M, Grade A, Z 275) zinc coated according to ASTM A 525 (ASTM A 525M).
3. Galvanized and Shop-Primed Steel Sheet: ASTM A 446, Grade A, G 60 (ASTM A 446M, Grade A, Z 180) zinc coated according to ASTM A 525 (ASTM A 525M); cleaned, pretreated, and primed with manufacturer's baked-on, lead- and chromate-free rust-inhibitive primer.
4. Profile Depth: 1-1/2 inches (38 mm).
5. Profile Depth: 2 inches (51 mm).

6. Profile Depth: 3 inches (76 mm).
7. Profile Depth: As indicated.
8. Design Uncoated-Steel Thickness: 0.0295 inch (0.75 mm).
9. Design Uncoated-Steel Thickness: 0.0358 inch (0.91 mm).
10. Design Uncoated-Steel Thickness: 0.0474 inch (1.20 mm).
11. Design Uncoated-Steel Thickness: 0.0598 inch (1.52 mm).
12. Span Condition: Simple span.
13. Span Condition: Double span.
14. Span Condition: Triple span or more.
15. Span Condition: As indicated.
16. Vent Slot Area: Manufacturer's standard vents slots providing 1-1/2 percent minimum open area.

1.024 ACCESSORIES

- A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.
- B Mechanical Fasteners: Manufacturer's standard, corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon steel fasteners; or self-drilling, self-threading screws.
- C Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 (4.8 mm) minimum diameter.
- D Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.
- E Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile indicated.

F Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

G Hanger Tabs: Manufacturer's standard piercing steel sheet hanger attachment devices for floor deck panels.

H Weld Washers: Manufacturer's standard uncoated-steel sheet weld washers, shaped to fit deck rib, 0.0598 inch (1.5 mm) thick with 3/8-inch (9.5-mm) minimum diameter prepunched hole.

I Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch- (1.8-mm-) thick minimum, of same material as deck panels, with 1-1/2-inch- (38-mm-) minimum deep level recessed pans and 3-inch- (76-mm-) wide flanges. Cut holes for drains in the field.

J Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071-inch- (1.8-mm-) thick minimum units, of same material as deck panels. Cut holes for drains in the field.

K Shear Connectors: ASTM A 108, Grade 1010 through 1020 headed stud type, cold-finished carbon steel, AWS D1.1, Type B.

L Steel Sheet Accessories: ASTM A 446, G 60 (ASTM A 446M, Z 180) coating class, galvanized according to ASTM A 525 (ASTM A 525M).

M Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

N Preset Inserts: Manufacturer's standard, UL-labeled single-piece preset inserts, fabricated from either steel sheet galvanized according to ASTM A 525, G 60 (ASTM A 525M, Z 180) coating class, or zinc sheet, with removable covers.

PART 3 EXECUTION

1.031 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

1.032 PREPARATION

- A. Do not place deck panels on concrete supporting structure until concrete has cured and is dry.
- B. Locate decking bundles to prevent overloading of supporting members.

1.033 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, and requirements of this Section.
- B. Install temporary shoring before placing deck panels when required to meet deflection limitations.
- C. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.
 - 1. Align cellular deck panels for entire length of run of cells and align cells at ends of abutting panels.
- D. Place deck panels flat and square and fasten to supporting framing without warp or deflection.
- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
- H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's instructions.

1.034 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 (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space welds an average of 12 inches (305 mm) apart, with a minimum of two welds per unit at each support.
3. Weld Washers: Install weld washers at each weld location.

B Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 36 inches (910 mm), using one of the following methods:

1. Mechanically fasten with self-drilling No. 10- (4.8-mm-) diameter or larger carbon steel screws.

C End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.
- 2

D Roof Sump Pans and Sump Plates: Install over openings provided in roof decking, and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.

E Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations.

Weld to substrate to provide a complete deck installation.

F Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's instructions to ensure complete closure.

G Sound-Absorbing Insulation: Install premolded, roll or strip sound-absorbing insulation according to deck manufacturer's instructions.

1.035 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. **Weld Diameter:** 5/8 inch (16 mm), nominal.
2. **Weld Spacing:** Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
3. **Weld Washers:** Install weld washers at each weld location.

B Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, or at intervals not exceeding 36 inches (910 mm), using one of the following methods:

1. **Mechanically fasten with self-drilling No. 10- (4.8-mm-) diameter or larger carbon steel screws.**

C End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. **End Joints:** Lapped.

D Shear Connectors: Weld shear connectors through deck to support framing according to AWS D1.1 and manufacturer's instructions. Butt end joints of deck panels; do not overlap.

E Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

F Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck according to SDI recommendations to provide tight-fitting closures at open ends of ribs and sides of

decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise

indicated.

G Maintain smooth cellular raceway interiors free of welds or mechanical fasteners.

H Install piercing hanger tabs not more than 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides, unless otherwise indicated.

1036 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing agency employed and paid by Owner will perform field quality-control testing.

B Field welds will be subject to inspection.

C Shear connector welds will be inspected and tested according to the requirements of AWS D1.1 for stud welding and as follows:

1. Shear connector welds will be visually inspected.
2. Bend tests will be performed when visual inspections reveal either less than a continuous 360 degree flash or welding repairs to any shear connector.
3. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to the requirements of AWS D1.1.

D Testing agency will report test results promptly and in writing to Contractor and Architect.

F Remove and replace work that does not comply with specified requirements.

G Additional testing will be performed to determine compliance of corrected work with specified requirements.

1.037 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.

B Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.

1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
2. Where shop-painted surfaces are exposed in-service, apply touchup paint to blend into adjacent surfaces.

C Touchup Painting: Cleaning and touchup painting of field welds, abraded areas, and rust spots, as required after erection and before proceeding with field painting, are included in Division 9 Section "Painting."

C Provide final protection and maintain conditions to ensure steel decking is without damage or deterioration at time of Substantial Completion.

*****END OF SECTION*****

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior load-bearing wall framing.
2. Interior load-bearing wall framing.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: **As follows:**

- a. Dead Loads: **40 psf.**
- b. Live Loads: **60 psf.**
- c. Roof Loads: **20 psf.**
- d. Wind Loads: **145mph.**
- e. Seismic Loads: **Seismic Zone 3 (Z=0.30); Soil Profile type S_D; Seismic Importance factor(I)=1.25**

2. Deflection Limits: Design framing systems to withstand[**design loads**] without deflections greater than the following:

- a. Exterior Load-Bearing Wall Framing: Horizontal deflection of **1/240** of the wall height.
- b. Interior Load-Bearing Wall Framing: Horizontal deflection of **1/240** of the wall height under a horizontal load of **5 lbf/sq. ft. (239 Pa).**
- c. Exterior Non-Load-Bearing Framing: Horizontal deflection of **1/240** of the wall height.

1.3 SUBMITTALS

A. Product Data: For each type of 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.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification data.

- E. Product test reports.
- F. Research/evaluation reports.

1.4 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
- E. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: **ST50H (ST340H)**.
 - 2. Coating: **G60 (Z180)**.

2.2 LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: **0.0538 inch (1.37 mm)**.
 - 2. Section Properties: **section modulus: $S_x=1.452$, moment of inertia: $I_x=4.911$, and allowable moment: $M_a=28.70$.**
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and same minimum base-metal thickness as steel studs.

2.3 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members, unless otherwise indicated.
- B. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- C. Anchor Bolts: ASTM F 1554, Grade **36**, threaded carbon-steel **hex-headed bolts** and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by **hot-dip process according to ASTM A 153/A 153M, Class C**.
- D. 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.
- E. 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.
- F. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.4 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: **ASTM A 780**.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, **1/4 inch (6.4 mm)** thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- C. Install framing members in one-piece lengths.
- D. 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.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. 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 (1:960)** and as follows:
 - 1. Space individual framing members no more than plus or minus **1/8 inch (3 mm)** from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
 - 1. Anchor Spacing: **To match stud spacing.**
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of **1/8 inch (3 mm)** between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
 - 1. Stud Spacing: **16 inches (406 mm).**
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
 - F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
 - G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
 - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
 - 2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
 - H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
 - 1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
 - I. Install horizontal bridging in stud system, spaced **48 inches (1220 mm)**. Fasten at each stud intersection.
 - 1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to **6 inches (150 mm)** deep.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
 - J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
 - K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.
- 3.4 FIELD QUALITY CONTROL
- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Field and shop welds will be subject to testing and inspecting.
 - C. Testing agency will report test results promptly and in writing to Contractor and Architect.
 - D. Remove and replace work where test results indicate that it does not comply with specified requirements.

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

3.5 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 that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Steel **tube** railings.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

- a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

- a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
- b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

- a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- b. Uniform load of 25 lbf/sq. ft. (1.2 kN/sq. m) applied horizontally.
- c. Infill load and other loads need not be assumed to act concurrently.

- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 SUBMITTALS

- A. Product Data: For grout, anchoring cement, and paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- C. Samples: For each exposed finish required.

- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

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 Pipe and Tube Railings:
 - a. Pisor Industries, Inc.
 - b. Sharpe Products.
 - c. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.2 METALS

- A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

- B. Steel and Iron:

1. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
2. Tubing: **ASTM A 500 (cold formed)**.
3. Plates, Shapes, and Bars: ASTM A 36/A 36M.
4. Castings: Either gray or malleable iron, unless otherwise indicated.
 - a. Gray Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.
 - b. Malleable Iron: ASTM A 47/A 47M.
5. Expanded Metal: ASTM F 1267, Type II (**expanded and flattened**), Class 1 (uncoated).
6. Woven-Wire Mesh: Intermediate-crimp, **2-inch (50-mm)** woven-wire mesh, made from **0.135-inch (3.5-mm)** nominal diameter wire complying with **ASTM A 510 (ASTM A 510M)**.

2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: Provide concealed fasteners, unless unavoidable or standard for railings indicated.

1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

- B. Anchors: Provide **cast-in-place** anchors, 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.

- C. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- D. Shop Primers: Provide primers that comply with Division 09 **painting Sections**.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
- F. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
- G. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer compatible with finish paint systems indicated, and complying with SSPC-Paint 5.
- H. Grout and Anchoring Cement: Factory-packaged, nonshrink, nonmetallic grout complying with ASTM C 1107; or water-resistant, nonshrink anchoring cement; recommended by manufacturer for exterior use.

2.4 FABRICATION

- A. General: Fabricate railings to comply with design, dimensions, and details indicated, **but not less than that required to support structural loads**.
- B. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
- C. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds, using manufacturer's standard system of sleeve and socket fittings.
- D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings.
- E. Form changes in direction **by bending or by inserting prefabricated elbow fittings**.
- F. Form curves by bending in jigs to produce uniform curvature; maintain cross section of member throughout bend without cracking or otherwise deforming exposed surfaces.
- G. Close exposed ends of railing members with prefabricated end fittings.
- H. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
- J. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into **1-by-1/2-by-1/8-inch (25-by-13-by-3-mm)** metal channel frames.

2.5 FINISHES

- A. Steel and Iron:

1. Galvanized Railings: Hot-dip galvanize **exterior indicated** railings, after fabrication, to comply with ASTM A 123/A 123M. Provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
2. Shop-Primed Galvanized Railings: After galvanizing, clean railings, treat with metallic-phosphate process, and apply primer to comply with SSPC-PA 1.
3. Shop-Primed Steel Finish: Prepare to comply with **SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning"** and apply primer to comply with SSPC-PA 1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation.
 1. Set posts plumb within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.
 2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet (5 mm in 3 m)**.
- B. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Anchor posts in concrete by inserting into **formed or core-drilled holes** and grouting annular space.
- D. Anchor posts to metal surfaces with oval flanges.
- E. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- F. Attach handrails to wall with wall brackets.
 1. Use type of bracket with **flange tapped for concealed anchorage to threaded hanger bolt**.
 2. For wood stud partitions, use hanger or lag bolts set into wood backing between studs.
 3. For steel-framed partitions, fasten to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
 4. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.
- G. Adjusting and Cleaning:
 1. 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.
 2. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055213

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior frames and jambs.
 - 2. Wood cabinets.
 - 3. Plastic-laminate cabinets.
 - 4. Plastic-laminate countertops.
- B. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips unless concealed within other construction before woodwork installation.

1.2 SUBMITTALS

- A. Product Data: For cabinet hardware and accessories and finishing materials and processes.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples:
 - 1. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge.
 - 2. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished.
 - 3. Plastic-laminates, for each type, color, pattern, and surface finish.
 - 4. Thermoset decorative panels, for each type, color, pattern, and surface finish.
 - 5. Solid-surfacing materials.
- D. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of woodwork.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards."

1.4 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.

PART 2 - PRODUCTS

2.1 WOODWORK FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide interior architectural woodwork by one of the following:

2.2 MATERIALS

- A. Wood Species and Cut for Transparent Finish: Red oak, plain sawn or sliced.
- B. Wood Species for Opaque Finish: Any closed-grain hardwood.
- C. Wood Products:
 - 1. Hardboard: AHA A135.4.
 - 2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1 made with adhesive containing no urea formaldehyde.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPAC20 (lumber) and AWPAC27 (plywood). Use Exterior Type or Interior Type A. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Kiln-dry material after treatment.
- B. Fire-Retardant Particleboard: Panels made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
- C. Fire-Retardant Fiberboard: ANSI A208.2 medium-density fiberboard panels made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture with flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural woodwork, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Butt Hinges: **2-3/4-inch (70-mm)**, 5-knuckle steel hinges made from **0.095-inch- (2.4-mm-)** thick metal, and as follows:
 - 1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening.

- D. Back-Mounted Pulls: BHMA A156.9, B02011.
- E. Catches: Magnetic catches, BHMA A156.9, B03141.
- F. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
- G. Door Locks: BHMA A156.11, E07121.
- H. Drawer Locks: BHMA A156.11, E07041.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
 - 2. Satin Stainless Steel: BHMA 630.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, fire-retardant-treated, kiln-dried to less than 15 percent moisture content.
- B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

- A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
 - 1. Interior Woodwork Grade: Premium.
- B. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered, exposed surfaces and 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. Fire Rating: 60 minutes.
- C. Plastic-Laminate Cabinets:
 - 1. AWI Type of Cabinet Construction: **Flush overlay**.
 - 2. WI Construction Style: **Style A, Frameless**.
 - 3. WI Construction Type: **Type I, multiple self-supporting units rigidly joined together**.
 - 4. WI Door and Drawer Front Style: **Flush overlay**.
 - 5. Reveal Dimension: **As indicated**.
 - 6. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate as follows:
 - a. Horizontal Surfaces Other Than Tops: Grade HGS.
 - b. Vertical Surfaces: Grade HGS.
 - c. Edges: **Grade HGS**.

7. Materials for Semiexposed Surfaces Other Than Drawer Bodies: **High-pressure decorative laminate, Grade VGS.**
8. Drawer Sides and Backs: **Solid-hardwood lumber.**
9. Drawer Bottoms: **Hardwood plywood.**
10. Colors, Patterns, and Finishes: **As indicated by manufacturer's designations.**
11. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of **solid colors, wood grains, patterns**, finishes.
12. Provide dust panels of **1/4-inch (6.4-mm)** plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

D. Plastic-Laminate Countertops:

1. High-Pressure Decorative Laminate Grade: **HGS.**
2. Colors, Patterns, and Finishes: **As indicated by manufacturer's designations.**
3. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of **solid colors wood grains patterns** finishes.
4. Edge Treatment: **Same as laminate cladding on horizontal surfaces.**
5. Core Material at Sinks: **exterior-grade plywood.**

2.7 SHOP FINISHING

- A. Finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.
- B. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling.
- C. Transparent Finish:
 1. Grade: Premium.
 2. AWI Finish System: Conversion varnish.
- D. Opaque Finish:
 1. Grade: Premium.
 2. AWI Finish System: Conversion varnish
 3. Color: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas. Examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

- C. Install woodwork level, plumb, true, and straight to a tolerance of **1/8 inch in 96 inches (3 mm in 2400 mm)**. Shim as required with concealed shims.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. 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. Use fine finishing nails **or finishing screws** for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. **Scarf running joints and stagger in adjacent and related members**. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
- G. 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.
 - 1. Fasten wall cabinets through back, near top and bottom, at ends and not more than **16 inches (400 mm)** o.c. with **No. 10 wafer-head screws sized for 1-inch (25-mm)** penetration into wood framing, blocking, or hanging strips.
- H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

END OF SECTION 064023

SECTION 070150.19 - PREPARATION FOR RE-ROOFING PART 1

- GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof tear-off.
 - 2. Roof re-cover preparation.
 - 3. Removal of base flashings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of new membrane roofing system. B.
Reroofing Conference: Conduct conference at Project site.

1.4 PROJECT CONDITIONS

- A. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- B. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

PART 2 - PRODUCTS

2.1 AUXILIARY REROOFING MATERIALS

- A. General: Auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new membrane roofing system.
- B. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FM Approval's "Approval Guide."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing membrane roofing system that is indicated to remain and be covered with new roof membrane.
- B. Coordinate shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.
- C. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
- D. Verify that rooftop utilities and service piping have been shut off before beginning the Work.

3.2 ROOF TEAR-OFF

- A. General: Notify Contractor each day of extent of roof tear-off proposed for that day. B.
Remove aggregate ballast from roofing membrane and dispose.
- C. Remove loose aggregate from aggregate-surfaced built-up bituminous roofing using a power broom.
- D. Remove pavers and accessories from roofing membrane
- E. Partial Roof Tear-Off: Remove existing roofing membrane and other membrane roofing system components down to the deck where indicated on the Drawings.
 - 1. Remove cover boards roof insulation and substrate boards.
 - 2. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen and felts and wet felts.
 - 3. Remove excess asphalt from steel deck. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.
 - 4. Remove fasteners from deck.

3.3 DECK PREPARATION

- A. Inspect deck after partial tear-off of membrane roofing system.
- B. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263 or by pouring 1 pint (0.5 L) of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with roofing work if moisture condenses under the plastic sheet or if asphalt test sample foams or can be easily and cleanly stripped after cooling.

- C. If broken or loose fasteners that secure deck panels to one another or to structure are observed or if deck appears or feels inadequately attached, immediately notify Architect. Do not proceed with installation until directed by Architect.
- D. If deck surface is not suitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

3.4 EXISTING BASE FLASHINGS

- A. Remove existing base flashings around parapets, curbs, walls, and penetrations.
 - 1. Clean substrates of contaminants such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish.

3.5 DISPOSAL

- A. Collect and place demolished materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Transport and legally dispose of demolished materials off Owner's property. END OF

SECTION 070150.19

CSI SECTION 07 24 00 - Exterior Insulation & Finish System (EIFS) - Class PB

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Installation of Parex Standard System EIFS

1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 04 20 00 - Unit Masonry
- C. Section 06 16 00 - Sheathing
- D. Section 07 62 00 - Sheet Metal Flashing and Trim
- E. Section 07 90 00 - Joint Protection
- F. Section 08 50 00 - Windows
- G. Section 09 21 16 - Gypsum Board Assemblies

1.3 REFERENCES

- A. ASTM B117 - Test Method for Salt Spray (Fog) Testing.
- B. ASTM C203 - Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation
- C. ASTM C1135 - Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
- D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
- E. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
- F. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.
- G. ASTM D2294 - Standard Test Method for Creep Properties of Adhesives in Shear by Tension Loading (Metal-to-Metal).
- H. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
- J. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
- K. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings
- L. ASTM E119-00 - Standard Test Method for Fire Tests of Building Construction and Materials.
- M. ASTM E330 - Test Method for Structural Performance by Uniform Static Air Pressure Difference.
- N. ASTM E331 - Test Method for Water Penetration by Uniform Static Air Pressure Difference.
- O. ASTM E695 - Method for Measuring Relative Resistance to Impact Loading.
- P. ASTM E2134 - Standard Test Method for Evaluating the Tensile-Adhesion Performance of an Exterior Insulation and Finish System (EIFS)
- Q. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies
- R. ASTM E2430 - Standard Specification For Expanded Polystyrene ("EPS") Thermal Insulation Boards For Use In Exterior Insulation and Finish Systems ("EIFS")
- S. ASTM E2485 - Standard Test Method for Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water Resistive Barrier Coatings
- T. ASTM E2486 - Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
- U. ASTM G155 and G153 - Accelerated Weathering for Exposure of Nonmetallic Materials.
- V. Federal Specification TT-C-555B – Coating, Textured (For Interior and Exterior Masonry Surfaces)
- W. MIL STD 810B - Military Standard, Environmental Test Methods

- X. NFPA 259 -Test Method for Potential Heat of Building Materials.
- Y. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source.
- Z. NFPA 285 - Standard Method of Test for the Evaluation of Flammability characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components Using the Intermediate-scale, Multistory Test Apparatus.

1.4 SYSTEM DESCRIPTION

A. Description of Parex Standard System :

1. An Exterior Insulation and Finish System (EIFS) consisting of Adhesive, Expanded Polystyrene Insulation (EPS) Board, Base Coat with embedded Reinforcing Fabric Mesh, Primer (Optional), and Finish Coat. This system is installed over glass mat gypsum sheathing, cement board sheathing, CDX plywood, Exposure 1, OSB, concrete or CMU. For OSB restrictions see the *Parex Acceptable Substrates and Areas of Use Technical Bulletin*.

B. Parex EIFS Functional Criteria:

1. General:
 - a. Insulation Board: At system termination, completely encapsulate insulation board edges by mesh reinforced base coat, substrate or drainage track (limited to terminations at foundation for non-combustible construction). The use of and maximum thickness of insulation board shall be in accordance with applicable building codes and Parex USA requirements.
 - b. Flashing: Flashing shall be continuous and watertight. Flashing shall be designed and installed to prevent water infiltration behind the EIFS. Refer to Division 07 Flashing Section for specified flashing materials.
 - c. The configuration of the water resistive barrier, drainage plane, flashing with Parex materials, must allow for the egress of incidental moisture
 - d. See Current ICC Evaluation Service Report or Contact Parex Technical Department for Design Windloads.
 - e. Inclined surfaces shall follow the guidelines listed below:
 - (1) Minimum slope: 6 in (152 mm) of vertical rise in 12 in (305 mm) of horizontal run.
 - (2) For sloped surfaces, run of slope shall be a maximum of 12 in (305 mm).
 - (3) Usage not meeting above criteria shall be approved by Parex USA in writing prior to installation.
 - f. The building interior shall be separated from the insulation board by ½ in (12.7 mm) of gypsum board or equivalent 15 minute thermal barrier.
2. Performance Requirements
 - a. System to meet the performance and testing requirements of the International Code Council Acceptance Criteria AC 219
 - b. Shall meet the testing requirements of the Parex Product Performance Sheet.
3. Substrate Systems:
 - a. Shall be engineered to withstand applicable design loads including required safety factor.
 - b. Maximum deflection of substrate system under positive or negative design loads shall not exceed L/240 of span except as otherwise approved in writing by Parex USA prior to installation.
 - c. Substrate dimensional tolerance: Flat within ¼ in (6.4 mm) in any 4 ft (122 cm) radius.
 - d. Surface irregularities: Sheathing not over ⅛ in (3 mm); masonry not over ³⁄₁₆ in (4.8 mm).
4. Impact Resistance Classification: Parex Standard System shall be classified in accordance with ASTM E2486 classification and impact ranges as follows.
 - a. High Impact Resistance, 90-150 in-lbs (10.2–17.0 J) Impact Range
5. Expansion Joints: Continuous expansion joints shall be installed at the following locations in accordance with manufacturer's recommendations:
 - a. At building expansion joints.

- b. At substrate expansion joints.
- c. At floor lines in wood frame construction.
- d. Where Parex EIFS panels abut one another.
- e. Where Parex EIFS abuts other materials.
- f. Where significant structural movement occurs, such as at
 - (1) Changes in roof line.
 - (2) Changes in building shape and/or structural system.
- g. Where substrate changes. (For exceptions to joints at substrate changes, contact the Parex USA Technical Department)
- 6. Manufacturer's Detail:
 - a. Parex EIFS latest published information shall be followed for standard detail treatments.
 - b. Non-standard detail treatments shall be as recommended by Parex USA, approved by Project Designer and be part of the Contract Documents.
- 7. Building Code Conformance: Parex EIFS shall be acceptable for use on this project under building code having jurisdiction.

1.5 SUBMITTALS

- A. General: Submit Samples, Evaluation Reports and Certificates in accordance with Division 01 General Requirements Submittal Section.
- B. Samples: Submit samples for approval. Samples shall be of materials specified and of suitable size as required to accurately represent each color and texture used on project. Prepare each sample using same tools and techniques for actual project application. Maintain and make available, at job site, approved samples.
- C. Manufacturer's Warranty: Submit sample copies of Manufacturer's Warranty indicating Single Source Responsibility.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Shall have marketed Exterior Insulation and Finish Systems in United States for at least ten years.
 - a. Shall have completed projects of same building size and type as this project.
 - 2. Applicator:
 - a. Shall have attended a Parex USA Educational Seminar for installation of system.
 - b. Shall possess a current certificate of education.
 - c. Shall be experienced and competent in installation of plaster-like materials.
- B. Regulatory Requirements:
 - 1. Insulation Board: Shall be produced and labeled under a third party quality program as required by applicable building code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver Parex Standard System products in original packaging with manufacturer's identification.
- B. Storage: Store EIFS materials supplied by Parex USA in a cool, dry location, out of sunlight, protected from weather and other harmful environment, and at a temperature above 40°F (4°C) and below 110°F (43°C) in accordance with manufacturer's instructions. Store insulation board flat.

1.8 PROJECT / SITE CONDITIONS

- A. Installation Ambient Air Temperature: Minimum of 40°F (4°C) and rising, and remain so for 24 hours thereafter.
- B. Substrate Temperature: Do not apply Parex materials to substrates whose temperature are below 40°F (4°C) or contain frost or ice.
- C. Inclement Weather: Do not apply Parex materials during inclement weather, unless appropriate protection is employed.

- D. Sunlight Exposure: Avoid, when possible, installation of the Parex materials in direct sunlight. Application of Parex Finishes in direct sunlight in hot weather may adversely affect aesthetics.
- E. Parex materials shall not be applied if ambient temperature exceeds 120°F (49°C) or falls below 40°F (4°C) within 24 hours of application. Protect base coat from uneven and excessive evaporation during hot, dry weather.
- F. Prior to installation, the wall shall be inspected for surface contamination, or other defects that may adversely affect the performance of the Parex materials and shall be free of residual moisture.

1.9 COORDINATION AND SCHEDULING:

- A. Coordination: Coordinate Parex Standard System installation with other construction operations.

1.10 WARRANTY

- A. Warranty: Upon request, at completion of installation, provide Parex Standard System Limited Warranty. See Parex's warranty schedule for available Parex EIFS Warranties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Parex USA, Inc., 4125 E. La Palma Ave., Suite 250, Anaheim, CA 92807
- B. Components: Obtain components of Parex Standard System from authorized distributors. No substitutions or additions of other materials are permitted without prior written permission from Parex USA for this project.

2.2 MATERIALS

- A. Adhesives
 - 1. Parex 121 Base Coat & Adhesive: 100% acrylic polymer based, requiring the addition of portland cement; used as an adhesive to laminate EPS Insulation Board to the substrate. Not for use with wood based sheathing
 - 2. Parex 121 Dry Base Coat & Adhesive: Copolymer based, factory blend of cement and proprietary ingredients; requiring the addition of water only, used as an adhesive to laminate EPS Insulation Board to the substrate. Not for use with wood based sheathing
 - 3. Parex 302 ABC-N1 Base Coat & Adhesive: 100% acrylic polymer base, ready to use, applied without the addition of cement.
 - 4. Parex 303 Sheathing Adhesive: 100% acrylic polymer based; ready to use, applied without the addition of cement; used as an adhesive to laminate EPS Insulation Board to gypsum sheathing, glass mat gypsum sheathing and wood based sheathing.
- B. Insulation Board: In compliance with manufacturer's requirements for Standard System EIFS.
 - 1. Produced and labeled under a third party quality program as required by applicable building code; and produced by a manufacturer approved by Parex USA.
 - 2. Shall conform to ASTM C578 and ASTM E 2430, Type I and the Parex USA specification for Molded Expanded Polystyrene Insulation board.
 - 3. Maximum size shall be 2 ft x 4 ft (610 mm x 1219 mm).
 - 4. Thickness: ¾ in, minimum (19 mm)
- C. Base Coats:
 - 1. 121 Base Coat: 100% acrylic polymer base, requiring the addition of portland cement.
 - 2. 121 Dry Base Coat: Copolymer based, factory blend of cement and proprietary ingredients requiring addition of water.
 - 3. 302 ABC-N1 Base Coat & Adhesive: 100% acrylic polymer base, ready to use, applied without the addition of cement.

EDITOR NOTE: RETAIN BELOW STANDARD MESH FOR PAREX STANDARD SYSTEM FOR STANDARD IMPACT RESISTANCE CLASSIFICATION.

- D. Parex Reinforcing Mesh:
 - 1. 355 Standard Mesh: Weight 4.5 oz. per sq. yd. (153 g/sq m); coated for protection against alkali. Standard reinforcement of Parex EIFS, or for use with High Impact 358.14 Mesh, or Ultra High Impact 358.20 Mesh.

2. 356 Short Detail Mesh: Reinforcing mesh used for backwrapping and details.
 3. 352 Self Adhesive Detail Mesh: Reinforcing mesh used for complex details.
 4. 358.10 Intermediate Impact 10 Mesh: Weight 12 oz per sq. yd. (407 g/sq m) Reinforcing mesh used with Parex Standard System, to achieve ASTM E2486 intermediate impact strength.
 5. 358.14 High Impact 14 Mesh: Weight 15 oz. per sq. yd. (509 g/sq m) Reinforcing mesh used with Parex Standard System; to achieve ASTM E2486 high impact strength.
 6. 358.20 Ultra High Impact 20 Mesh: Weight 20 oz. per sq. yd. (678 g/sq m) Reinforcing mesh used with Parex Standard System; to achieve ultra-high impact strength.
 7. 357 Corner Mesh: Reinforcing mesh used as corner reinforcement; required when using Ultra-High Impact 20 Mesh.
- E. Parex Primers:
1. 310 Primer: 100% acrylic based coating to prepare surfaces for Parex finishes.
 2. 313 Sanded Primer: 100% acrylic based coating to prepare surface for Parex Cerastone and Spraystone finishes.
- F. Parex Finish:
1. Parex DPR Standard Finish: Factory blended, 100% acrylic polymer based finish, integrally colored.
 - a. Finish type, texture and color as selected by Project Designer.
- G. Water: Clean, cool, potable water
- H. Portland Cement: ASTM C150, Type I or Type I-II.

2.3 RELATED MATERIALS AND ACCESSORIES

- A. Substrate Materials:
1. Glass mat gypsum sheathing: Minimum $\frac{1}{2}$ in thick, conforming to ASTM C1177.
 2. Cement Fiber Sheathing: Minimum $\frac{1}{2}$ in thick, conforming to ASTM C1325
 3. Gypsum Sheathing: Minimum $\frac{1}{2}$ in thick, core-treated, weather-resistant, exterior gypsum sheathing complying with ASTM C1396.
 4. Plywood: Minimum $\frac{7}{16}$ in thick, Minimum 4-ply APA-Engineered Wood Association Exposure 1 or Exterior grade C-D or better. Installed with C or better side out gapped $\frac{1}{8}$ in at all edges
 5. Oriented Strand Board (OSB): $\frac{7}{16}$ in - $\frac{1}{2}$ in Wall-16 or Wall-24, approved by the APA, TECO, or PSI/PTL. Stamped as Exposure 1 or Exterior Sheathing with a PS2 or PRP-108 rating.
 6. Concrete Masonry Units (CMU): Non-painted (uncoated).
 7. Concrete (poured or pre-cast).
 8. Other Approved by Parex USA in writing prior to the project.
- B. Flashing: Refer to Division 07 Flashing Section for flashing materials.
- C. Sealant System:
1. Sealant for expansion joints between panelized Parex EIFS sections shall be ultra-low modulus designed for minimum 100% elongation and minimum 50% compression and as selected by Project Designer.
 2. Sealant for perimeter seals around window and door frames and other wall penetrations shall be low modulus, designed for minimum 50% elongation and minimum 25% compression, and as selected by Project Designer.
 3. Sealants shall conform to ASTM C920, Grade NS.
 4. Expansion joints between sections of Parex EIFS shall have a minimum width of $\frac{3}{4}$ in (19 mm).
 5. Perimeter seal joints shall be a minimum width of $\frac{1}{2}$ in (12.7 mm).
 6. Sealant backer rod shall be closed-cell polyethylene foam.
 7. Apply sealant to tracks or base coat of Parex EIFS.
 8. Refer to Parex USA current bulletin for listing of sealants which have been tested and have been found to be compatible with Parex EIFS.
 9. Color shall be as selected by Project Designer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify project site conditions under provisions of Section 01 00 00.
- B. Compliance: Comply with manufacturer's instructions for installation of Parex Standard.
- C. Substrate Examination: Examine prior to Parex Standard System installation as follows:
 - 1. Substrate shall be of a type approved by Parex USA . Plywood and OSB substrates shall be gapped $\frac{1}{8}$ in (3.2 mm) at all edges. Cut edges (non-factory edges) must also be sealed with a Parex USA water-resistive coating.
 - 2. Substrate shall be examined for soundness, and other harmful conditions.
 - 3. Substrate shall be free of dust, dirt, laitance, efflorescence, and other harmful contaminants.
 - 4. Substrate construction in accordance with substrate material manufacturer's specifications and applicable building codes.
- D. Sealants and Backer Rod: To be installed, where required, in accordance with the sealant manufacturer's specifications and published literature, and using the sealant manufacturer's recommended primers.
- E. Advise Contractor of discrepancies preventing installation of the Parex Standard System. Do not proceed with the Parex Standard System Assembly work until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. Protection: Protect surrounding material surfaces and areas during installation of system.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 MIXING

- A. Mix Parex proprietary products in accordance with manufacturer's instructions.

3.4 APPLICATION

- A. General: Installation shall conform to this specification and Parex EIFS Application Guide, written instructions and drawing details.
 - 1. Plywood and OSB substrate cut edges (non-factory edges) must be sealed with a Parex USA water-resistive coating.
- B. Insulation Board
 - 1. Install back-wrap mesh or edge-wrap mesh at system terminations.
 - 2. Apply Parex adhesive to backs of insulation boards with a Parex drainage notched trowel, with ribbons of adhesive oriented in a vertical direction (parallel to the 2 ft (61 mm) dimension of the EPS board).
 - 3. Install insulation board without gaps in a running bond pattern and interlocked at corners.
 - 4. Rasp irregularities off insulation board after adhesive has dried a minimum of 24 hours..
- C. Apply base coat and fully embed mesh in base coat; include diagonal mesh patches at corners of openings and reinforcing mesh patches at joints of track sections. Apply multiple layers of base coat and mesh where required for specified impact resistance classification.
- D. Apply primer to base coat after drying. Primer may be omitted if it is not required by the manufacturer's product data sheets for the specified finish coat or otherwise specified for the project.
- E. Finish Coat: Apply finish coat to match specified finish type, texture, and color. Do not apply finish coat to surfaces to receive sealant. Keep finish out of sealant joint gaps.

3.5 CLEAN-UP

- A. Removal: Remove and legally dispose of Parex Standard System component debris material from job site.
- B. Clean EIFS surfaces and work area of foreign materials resulting from EIFS operations.

3.6 PROTECTION

- A. Provide protection of installed materials from water infiltration into or behind them.
- B. Provide protection of installed stucco from dust, dirt, precipitation, and freezing during installation.
- C. Provide protection of installed finish from dust, dirt, precipitation, freezing and continuous high humidity until fully cured and dry.
- D. Clean exposed surfaces using materials and methods recommended by the manufacturer of the material or product being cleaned. Remove and replace work that cannot be cleaned to the satisfaction of the Project Designer/Owner.

END OF SECTION

PRODUCT PERFORMANCE SHEET

EIFS Fire Performance	Method	ICC or ASTM Criteria	Results
Surface Burning Characteristics	ASTM E84	Individual components shall each have a flame spread <25, and smoke developed < 450	Flame Spread: 0 to 15 Smoke Developed: 0 to 15
Large-Scale Vertical Fire Spread	ASTM E108	No Requirement	No vertical or horizontal flame spread.
Fire Resistance	ASTM E119	Maintain fire resistance of existing rated assembly	1, 2, & 3 hour assemblies, See Current ICC Report
Radiant Heat Exposure	NFPA 268	No ignition @ 20 minutes	Pass
Intermediate Scale Multi-Story Fire Test	NFPA 285(UBC Standard 26-9)	Required for Non-combustible Construction	Pass, See Current ICC Report

EIFS Strength	Method	ICC or ASTM Criteria	Results
Flexural Strength	ASTM C203	No Requirement	60.6 psi (418 kPa)
Falling Ball Impact	ASTM D1037	No Requirement	92 to over 600 in-lbs
Creep Resistance of Adhesive	ASTM D2294	No Requirement	28 days 208 psf shear stress: no creep
Gardner Impact Test	ASTM D2794	No Requirement	25 to 200 in-lbs (mesh weight)
Transverse Wind Load	ASTM E330	Withstand positive and negative wind loads as specified	See Current ICC Report
Impact Load	ASTM E695	No Current Requirement	30 lb. Impact mass; no cracking of system
Tensile Bond Strength	ASTM E2134	Minimum 15 psi (103kPa)	Pass

EIFS Environmental Durability	Method	ICC or ASTM Criteria	Results
Abrasion Resistance	ASTM D 968	No cracking or loss of film at 528 quarts (500 L) of sand	Pass @ 500 Liters
Accelerated Weathering	ASTM G153 (ASTM G 23) ASTM G154	No deleterious effects* at 2000 hours when viewed under 5x magnification	2000 Hours: no deleterious effect 2000 Hours: no deleterious effect
Freeze/Thaw Resistance	ASTM E 2485	No deleterious effects* at 10 cycles when viewed under 5x magnification	60 cycles: no deleterious effect
Fungus Resistance	MIL STD 810B	No Requirement	28 days: no growth
Mildew Resistance	ASTM D 3273	No growth supported during 28 day exposure period	Pass
Water Penetration	ASTM E 331	No water penetration beyond the plane of the base coat/EPS board interface after 15 minutes at 6.24 psf (299 Pa)	Pass
Moisture Resistance	ASTM D2247	No deleterious effects at 14 day exposure	Pass
Salt Fog Resistance	ASTM B117	No deleterious effects* at 300 hours	500 hours: no deterioration
Wind Driven Rain	F.S. TT-C-555B	No Requirement	24 hours: no penetration of water

*No deleterious effects: no cracking, checking, crazing, erosion, rusting, blistering.

REINFORCING MESH IMPACT RESISTANCE	Classification	Impact Range (in-lbs)
355 Standard Mesh	Standard	25-49
358.10 Intermediate Impact 10 Mesh	Intermediate	50-89
358.14 High Impact 15 Mesh (Plus Standard Mesh)	High	90-150
358.20 Ultra High Impact 20 Mesh /Standard Mesh	Ultra High	>150

Where several tests on different materials are summarized, a range of values is shown. This summary has been prepared to provide quick but partial information on how certain combinations of Parex products perform during certain tests. It is not a complete description of the test procedures or of the results thereof. Parex USA will mail copies of original test reports at no charge on request. Please contact Parex USA if further information is required.

SECTION 07526 - MODIFIED BITUMEN SHEET ROOFING

PART 1 – GENERAL

1.01 SUMMARY

- A. Roof Insulation
- B. Insulation Fasteners
- C. Base Sheet
- D. Modified Bitumen Interply Membrane
- E. Modified Bitumen Sheet Roofing
- F. Modified Bitumen Flashings
- G. Roof Accessories
- H. Walkways
- I. Surfacing

1.02 RELATED SECTIONS

- A. Division 6 Section Carpentry: Wood Nailers.
- B. Division 7 Section Flashing and Sheet Metal: Metal Counter Flashings.
- C. Division 7 Section Roof Specialties: Roof Hatches, Prefabricated Curbs.
- D. Division 7 Section Sealants: Caulks, Sealants.
- E. Division 15 Section Drainage and Vent Systems: Roof Drains.

1.03 REFERENCES

- A. ASTM-American Society for Testing and Material
- B. AWPB-American Wood Preservers' Bureau
- C. ASTM D41-Asphalt Primer Used in Roofing
- D. NRCA-National Roofing Contractors Association
- E. ASTM D2178-Asphalt Glass Felt Used in Roofing
- F. ASTM-D4601-Asphalt Glass Felt Used in Roofing
- G. ASTM D312-Asphalt Used in Roofing
- H. UL-Underwriters Laboratories, Fire Classification
- I. RIC/TIMA-The Roof Insulation Committee of the Thermal Insulation Manufacturers Association
- J. SMACNA-Sheet Metal and Air Conditioning Contractors National Association
- K. FS HH-1-1972/Gen-Insulation Board, Thermal, Faced, Polyisocyanurate
- L. FS HH-1-529b-Insulation Board, Thermal, Mineral Aggregate
- M. ASTM C726-Insulation Board, Fiberglass
- N. ASTM C728-Insulation Board, Perlite
- O. ASTM D1227-Asphalt Emulsion as a Roof Coating
- P. ASTM D1863-Mineral Aggregate
- Q. ASTM D2824-Aluminum Pigmented Asphalt Roof Coating

1.04 REGULATORY REQUIREMENTS

- A. UL Classification: Class A
- B. Factory Mutual (FM) System Classification:
 - 1. FM 1-240: RoofNav Assembly #: 401124-399742-0
- C. Additional Test Agencies & Building Code Requirements:

1.05 SUBMITTALS

- A. Submit product data for:
 - 1. base sheet
 - 2. modified bitumen interply membrane
 - 3. modified bitumen cap sheet
 - 4. adhesive
 - 5. insulation
 - 6. coverboard
- B. When materials are specified or a particular make or trade name is specified, it shall be indicative of a standard required. Bidder proposing substitutes shall submit the following in accordance with Section 01631:
 - 1. Written application with explanation of why it should be considered.
 - 2. Accredited testing laboratory certificate comparing substitute's physical/performance attributes to those specified.
 - 3. Smallest standard package of adhesive, coating, mastic, sealant, ply sheet, insulation, fastener(s) and flashing materials.
 - 4. Three job references available for inspection where substitutes were used under similar conditions.
- C. Only substitutions approved in writing by Owner prior to scheduled installation will be considered.

1.06 QUALITY ASSURANCE

- A. Manufacturer
 - i. Shall provide local Technical Sales Representative to make start-up inspection and in-progress site inspections at regular intervals.
 - ii. Shall provide final inspection of completed roofing system and issuance of the warranty.
- B. Contractor
 - i. Roofing contractor shall be a registered applicator by the manufacturer.
 - ii. Contractor shall retain a two (10) year workmanship warranty for the specified system within the manufacturers warranty.
 - iii. Strict adherence to the manufacturers most current published specifications are to be followed. Deviations must be approved in writing by the architect and manufacturer prior to installation.
- C. Designation of Responsible Personnel
- D. Walkover Inspection
 - i. Attendance: Representative of Owner/Architect, General Contractor, Roofing Contractor and Manufacturer's Technical Representative.
- E. Final Inspection
 - i. Will be scheduled by roofing contractor upon job completion.
 - ii. Attendance: Representative of Owner/Architect, General Contractor, Roofing Contractor and Membrane Manufacturer's Technical Representative.
 - iii. Minimum agenda:
 - 1. Walkover inspection.
 - 2. Identification of problems which may impede issuance of warranty.
 - 3. Creation of punch list.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials.

- i. Deliver and store materials under provisions of Section 01600.
 - ii. Deliver materials to job-site in new, dry, unopened and well marked containers showing product and manufacturer's name, production date and/or product code. All materials delivered shall be on pallets.
 - iii. Deliver materials in sufficient quantity to allow continuity of work.
- B. Storage of Materials.
 - i. Storage of plies to be protected from water or extreme humidity.
 - ii. Store all roll roof materials on end to prevent their becoming deformed/damaged. Discard rolls which have flattened, creased or otherwise damaged.
 - iii. Place materials on pallets which are at least four (4) inches above the ground. Do not stack pallets.
 - iv. Rooftop Storage: Disperse materials to avoid concentrated loading.
 - v. Cover top and sides of all exterior stored materials with canvas tarpaulin (not polyethylene). Secure tarpaulin.
- C. Material Handling.
 - i. Handle plies and insulation to avoid bending, tearing or other damage during transportation and installation.
 - ii. Material handling equipment shall be selected and operated so as not to damage existing construction or applied roofing. Do not operate or situate material handling equipment in location(s) that will hinder smooth flow of vehicular or pedestrian traffic.
- D. Safety Requirements.
 - i. All application, material handling and associated equipment shall conform to and be in conformance with OSHA safety requirements.
 - ii. Comply with Federal, State, Local and Owner fire safety requirements.
 - iii. Maintain fire extinguishers within easy access whenever power tools, roofing kettles or torches are being used.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply roofing membrane during inclement weather.
- B. Do not apply roofing membrane to damp or frozen substrates.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during the same day.
- D. To assure good adhesion at the point of application, exercise care to maintain bitumen temperature of the roofing asphalt at the EVT designated on the asphalt carton.

1.09 WARRANTY

- A. Manufacturer shall provide: Ten (10) Workmanship and Materials Platinum Warranty.
- B. Certified Roofing Contractor shall provide: Ten (10) complementary Workmanship and Materials warranty

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Danosa Caribbean, Inc. Specification #2-ID-Forward Center
INSULATED DECKS ASSEMBLY # 2-ID

2.02 SHEET MATERIALS

- A. Modified Bitumen Base Sheet: **Esterdan R-36**

Modified Bitumen (SBS) base membrane with a heavy polyester mat reinforcement, protected with a polyethylene film. ASTM-D-6164 Type I Grade S

B. Modified Bitumen Membrane: **Esterdan RM-4**

SBS Modified Bitumen top membrane with a heavy polyester mat reinforcement, finished with a ceramic granules and resilient film as top protection surface area and burn-off film on the other side. ASTM-D-6164 Type I Grade G

C. Flashing Membrane: **Glasdan AL-80-4**

(SBS) Modified Bitumen flashing membrane with a fiberglass mat reinforcement, finished with aluminum clad top protection surface area and burn-off film on the other side. ASTM D-6298

2.03 BITUMINOUS MATERIAL

A. Asphalt Primer: ASTM D41, Danosa Primer.

B. Aluminum Coating: ASTM D2824, Richport Aluminum Roof Coating.

2.04 INSULATION

A. Base layer :

1. Polyisocyanurate *R-value 20 minimum*.

B. Coverboard:

1. Securerock Gypsum Fiber Roof Board ¼
or

2. DensDeck-Prime ¼

C. Tapered Insulation: Polyisocyanurate 4' x 4' Board

2.05 RELATED MATERIALS

A. Sealant: Chemlink M-1 or Novalink

B. Cants: Perlite or Ploy-Iso, ASTM C 728, 4" face.

C. Prefabricated Roof Hatches: Bilco, Milcor

D. Traffic Surfacing: DAN-O-PAD Walkway by Danosa Caribbean, Inc..

E. Penetrations Seal: Chem-Curb/E-Curb by Danosa Caribbean, Inc.

F. Grease Containment System: Grease Guard by Danosa Caribbean, Inc.

G. Roof Insulation Foam Adhesive: INSTA-STIK®, single component polyurethane adhesive dispensed from a portable pre-pressurized container by Danosa Caribbean, Inc.

H. Roof Isulation Low-Rise Foam Adhesive: OlyBond®, two- component polyurethane adhesive applied with portable or traditional spray foam equipment, by Danosa Caribbean, Inc.

I. Walkway Pads: Reinforced asphaltic composition pads with slip-resisting mineral-granule surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 1/2 inch (13 mm) thick, minimum. Pad Size: AS SHOW ON CONSTRUCTION DRAWINGS.

PART 3 - EXECUTION

3.01 EXAMINATION AND PROTECTION

A. Inspection

1. Verify installation conditions as satisfactory to receive work.

2. Do not install new roofing until all unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions.

3. Check projections, curbs and deck for inadequate anchorage, foreign material, moisture, or unevenness that would prevent quality of execution of the new roofing system.

B. General Workmanship

1. Substrate: Free of foreign particles prior to laying roof membrane.
2. Phased application: Not permitted, all plies shall be completed each day.
3. Confine equipment, storage of materials, debris and the operations and movement of workers within the limits agreed upon for the project.
4. Where wheeled or other traffic over partially completed roofing is unavoidable, provide adequate exterior protection to the roof.
5. Discontinue to apply asphalt where uncharacteristic foaming of asphalt is noted.
6. Wrapper and package materials: Not to be included in roof system.
7. Bitumen heating: Use low burner flames during initial melt-down. Circulate bitumen after initial melt-down. Maximum bitumen temperature: Shall at no time exceed its flash point, and asphalt shall not be heated above its blowing temperature for more than four(4) hours. Apply asphalt at the point of application within +/- 25 F. of its labeled EVT.
8. All metal and masonry shall be asphalt primed before fully adhering flashing sheets.
9. Mechanical Fasteners: Seated firmly with fastener heads flush or below surface.
10. Do not use insulation that is warped or damaged.
11. Base flashing height is not less than eight (8) inches above finished surface.

C. Protection

1. Contractor shall be responsible for protection of property during course of work. Lawn, shrubbery, paved areas and building shall be protected from damage at no extra cost.
2. Roofing, flashing and insulation shall be installed and sealed in a watertight manner on same day of installation or upon the arrival of inclement weather.
3. At the end of each work day, partial installation shall be sealed with water stops along edges to prevent water entry.
4. At the start of each work day, drains within daily work area shall be plugged. Plugs are to be removed at end of each work day or before arrival of inclement weather.
5. Preparation work shall be limited to those areas that can be covered with installed roofing material on same day or before arrival of inclement weather.
6. Arrange work sequence to avoid use of newly constructed roofing for storage, walking surface and equipment movement. Move equipment and ground storage areas as work progresses.

3.02 THERMAL INSULATION

- A. Do not use damaged or warped boards.
- B. The base layer or single layer of insulation shall be adhered to the concrete deck with foam adhesive (Olybond 500 or Insta-Stik) as indicated on RoofNav Assembly #: 401124-399742-0
- C. The Coverboard (Securerock or DensDeck-Prime) shall be adhered to the insulation with foam adhesive (Olybond 500 or Insta-Stik) as indicated on RoofNav Assembly #: 401124-399742-0

3.03 ROOF MEMBRANE APPLICATION

1. Substrate must be suitable to receive and hold roof system materials.
2. Start the installation of all membrane plies at the low point of the roof.

3. Chalk line where necessary to assure proper alignment and head lap widths of membrane plies.
4. Install the fiberglass base sheet by torch over the cover Board. Prime the Securock and let the primer dry first. Dens-Deck prime does not need priming.
5. Use half sheet widths as starter strip.
6. Overlap side laps three (3) inches and end laps six (6) inches. Stagger all end laps a minimum of twenty-four (24) inches.
7. The base sheet shall be, free from air pockets, wrinkles, fishmouths or tears.

Torch :

A. Work Area Preparation:

1. Adequate ventilation is required; enough ventilation such that personnel exposures to hazardous concentration of airborne contaminants are maintained at or below the allowable levels specified by OSHA or NIOSH.
 - a. Special care should be taken when torch welding is done in close or confined spaces due to possible concentration of contaminants and potential oxygen depletion. Appropriate precautions shall be observed. Use of mechanical ventilation to force air movement or use of approved respirators may be required.
2. All roof openings and edges should be protected or guarded in conformity with OSHA standards.
3. An awareness of other personnel in the torch welding area is mandatory, in tight quarters; only one (1) torch should be used.
4. The installer needs to have previously noted the locations of all pipes, curbs, or other roof top projections before working with torch welding.
5. Removal of combustible debris from the application area before the torch welding application begins is mandatory.
6. Appropriate precautions should be taken when torch welding in the proximity of gas pipe joints, HVAC coupling joints, or electrical service lines.
7. A base roofing ply shall cover all flammable materials (e.g. wood walls and wood fiber cant) before the torch welding application begins.
8. No torch welding shall be done unless the surrounding atmosphere is nonflammable and unless combustibles are moved away or properly protected from fire hazards.
9. Combustible materials which are present on a roof. Such as material wrappers, solvents, primers and roof cements shall be moved to a designated safe location.
10. Combustible materials which are present on a roof and are not movable shall be protected from fire hazards.
11. Combustible materials present on adjoining building surfaces (e.g. Shake shingles or wood siding) should be protected by covering with fire retardant blankets or a protective shield.
12. Sufficient fire extinguishing equipment shall be ready for use where torch welding roof work is being done. The fire extinguishing equipment should be portable fire extinguishers (Type ABC). In addition, buckets of sand and pails of water are advisable. Portable fire extinguishers shall be of the size and type required by local codes. A minimum of one 20 lbs. fire extinguisher per torch or torching machine should be on the roof at all times at the torching location. Special care shall be taken to check all fire extinguishers prior to and at the completion of the day's work to make sure they are full and operable

B. Application:

1. Start at the low point of the roof and progress to the high point. The membrane shall be installed perpendicular to the slope of the roof except when the slope exceeds 3" per foot. At vertical surfaces, abutting the roof, the membrane shall extend to the cant and must be heat welded to the underlying membrane previously installed.

- a. On slopes of more than three inches per foot, the seams should run parallel to the slope of the roof.
 2. All overlaps at the membrane seam shall be installed so as to have "up" slope laps over "down" slope laps.
 3. Membranes shall never be applied by any method except with a propane torch or electric heat welding devices designed for application of modified bitumen.
 - a. Flammable and solvent-based material (e.g. plastic cement) should not be exposed to flame.
 - b. When re-roofing, wood and fiber cant strips are extremely flammable and should be removed or protected.
 - c. Restaurant and food service exhaust vents can contain grease (*Grease Guard* grease containment system is recommended for these areas). All intake fans should be shut off during application with special care taken to keep torches away from openings. Exhaust vents for laundromats in condominiums, apartments and other multiple tenant dwellings can contain lint and debris. Open flames should be kept clear of all vents.
 4. Membranes must not be applied during adverse weather or without precautionary measures in temperatures below 40° F.
 5. The coiled membrane shall be unrolled approximately 15 feet, aligned, then the propane torch flame applied to the exposed outer surface of the coiled membrane until the bitumen reaches the proper application temperature, causing to develop a slight sheen. Care should be taken to avoid overheating which may result in damage to or improper adhesion of the membrane. The flame should be moved from side to side and up the lap edge while the membrane is slowly unrolled and adhered to the underlying surface. Subsequent shift of the roll shall be avoided after heating has begun. When complete, the remaining membrane shall be re-rolled and installed in the same manner. All end laps must be staggered so that no adjacent end laps coincide.
 6. The end laps shall be lapped six inches (6"), and the side laps must be lapped 3 inches (3"). A bitumen bleed-out approximately ¼" to ½" must be obtained at all seam areas.
 - a. To ensure the proper ½" flow of bitumen at the seam areas, a roller may be used. The man using roller should follow behind the torchman no more than 4 feet nor less than 3 feet to be sure that membrane will be in condition to produce proper bleed-out.
 7. The seam can be rolled with a hand roller or troweled with heated trowel. When one end is complete, re-roll the opposite end not yet torched, and install in the same manner.
 8. All end laps should be staggered a minimum of 15 feet.
 9. All LP-Gas cylinders shall be secured in a cylinder storage area at the end of each work day.
 10. All crews shall make a safety check of all equipment and LP-Gas cylinders prior to, and at the completion of the day's work.
 11. A fire watch shall be implemented on a daily basis after torch welding applications are completed. The job foreman or other designated personnel shall walk the area of application at the end of the day, checking for hot spots on the roof. A fire watch shall be conducted for a minimum of one hour after the last torch is shut off for the day.
- C. Seaming:
1. The bleed out of bitumen is troweled to insure a complete seal and watertight integrity.
 2. Proper troweling is achieved by using a heated trowel. The seam area and trowel should be heated simultaneously.
 3. Use heated trowel to achieve a smooth and water tight seam at all overlaps.

3.04 FLASHINGS

A. Modified Bitumen Flashings:

1. Set perlite cant in elastomeric mastic or mechanically attach.
2. Install new roofing two inches minimum beyond top edge of cant.
3. Prime the wall surface with asphaltic primer.
4. Adhere flashing membrane completely to roofing membrane. Lap sheeting ends six (6) inches. Ensure complete bond without wrinkles or voids.
5. Membrane coverage - Sufficient so that after being installed, membrane will be eight (8) inches minimum up the parapet wall. It will extend at least six (6) inches beyond to e of the cant onto the roof surface.
6. Mechanically attach top of membrane using fasteners every eight (8) inches on center.
7. See detail drawings for individual flashing requirements.

3.05 DAILY WATERSTOP TIE-IN

A. End of day

1. Remove debris from top ply of felt along termination, width eighteen (18) inches.
2. Adhere twelve (12) and eighteen (18) inch wide ply sheets from exposed deck to applied roofing with a continuous 1/16" inch thick application of asphalt. Glaze cut-off asphalt or water cut-off mastic. Extend eighteen (18) inch wide felt three (3) inches on both sides of the twelve (12) inch felt.
3. Install "deadman" insulation filler at insulation staggers.

B. Beginning of next day's work

1. Remove temporary connection by cutting felts evenly along edge of existing roof system. Remove "deadman" insulation fillers.

3.05 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size according to walkway pad manufacturer's written instructions.

1. Set walkway pads in cold-applied adhesive.

3.06 FIELD QUALITY CONTROL

A. Repair of deficiencies

1. Installations or details noted as deficient during Final Inspection must be repaired and corrected by applicator.

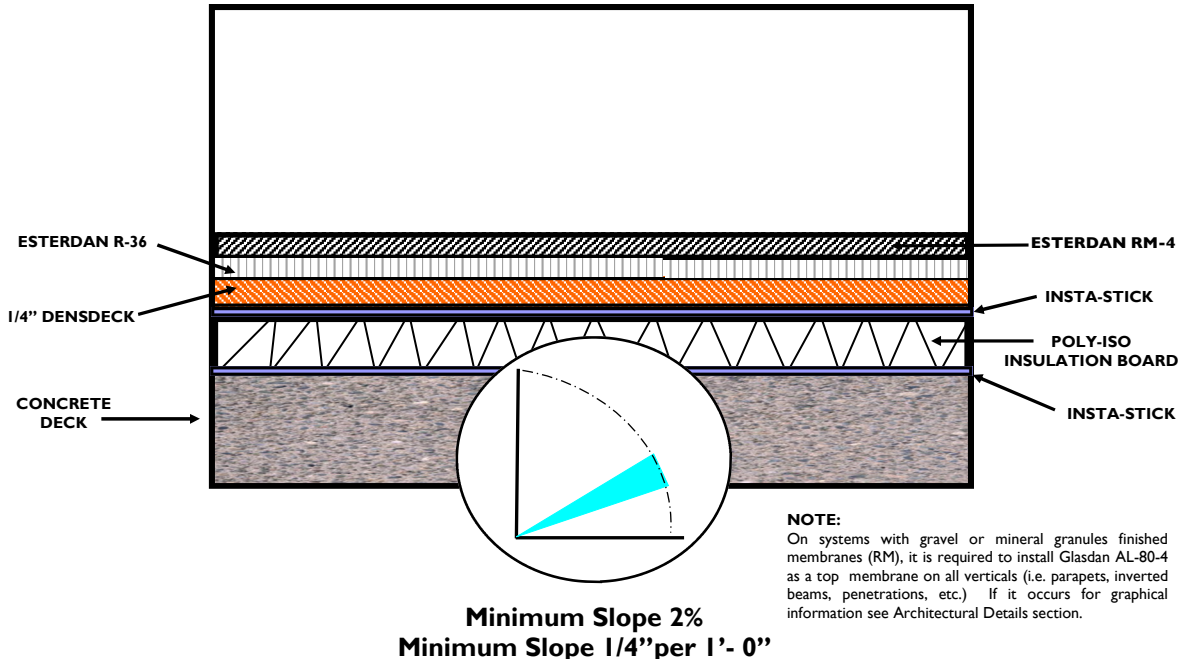
3.07 CLEANING

A. Immediately upon job completion, roof membrane and flashing surfaces shall be cleaned of debris.

B. Contractor shall be responsible for the cost of all clean-up procedures.

END OF SECTION 07526

INSULATED DECK



INSTALLATION PROCEDURE

- A. Over a properly clean and dry concrete deck proceed with the installation of 4'x4' Poly-Iso Insulation Boards adhered with Insta-Stick foam adhesive with 0.75" to 1.00" wide bead 12" o.c., followed by the installation of 1/4" Densdeck Prime with 0.75" to 1.00" wide bead 12" o.c.
- B. Determine direction of roof drainage and the corresponding low points of the roof. In the installation of bituminous membranes, the direction of both ends and side laps shall be such that the direction of drainage will be over the laps.
- C. Proceed with the installation of the base membrane **Esterdan R36** fully torched over Densdeck previously installed.
- D. Proceed with the installation of the top membrane **Esterdan RM-4**, (fully torched), heat fusing the entire surface to the lower membrane, **Esterdan R-36**.
- E. Revise the upper surface of the lapping joints with a heated rounded-nosed trowel. Precaution must be taken so that the seam of the base ply of **Esterdan R-36**, already adhered will lay in the middle of the width of the top layer, **Esterdan RM-4**
- F. Retouch seams in the **Esterdan RM-4** applied with Aluminum Coating to protect ex-posed asphalt during the seaming process.² **NOTES:**
 - G.
 1. As manufactured by Danosa Caribbean, Inc. according to ASTM D-41 or Federal Specifications SS-A-701 or any other as approved by Danosa Caribbean, Inc.
 2. For detailed information and installation instructions, see Specifications 007526



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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard hollow metal **doors and frames**.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required.
- E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.3 QUALITY ASSURANCE

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at **as close to neutral pressure as possible** according to **NFPA 252** and **UBC Standard 7-2**.
 - 1. Temperature-Rise Limit: **At vertical exit enclosures and exit passageways**, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F (250 deg C)** above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Light Frame 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 257** or **UL 9** and **UBC Standard 7-4**. Label each individual glazed lite.
- C. Smoke-Control Door Assemblies: Comply with **NFPA 105** or **UL 1784** and **UBC Standard 7-2**.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
1. Amweld Building Products, LLC.
 2. Benchmark; a division of Therma-Tru Corporation.
 3. Ceco Door Products; an Assa Abloy Group company.
 4. Curries Company; an Assa Abloy Group company.
 5. Deansteel Manufacturing Company, Inc.
 6. Firedoor Corporation.
 7. Fleming Door Products Ltd.; an Assa Abloy Group company.
 8. Habersham Metal Products Company.
 9. Kewanee Corporation (The).
 10. Mesker Door Inc.
 11. Pioneer Industries, Inc.
 12. Security Metal Products Corp.
 13. Steelcraft; an Ingersoll-Rand company.
 14. Windsor Republic Doors.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum **G60 (Z180) or A60 (ZF180)** metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), **40Z (12G)** coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Grout: ASTM C 476, except with a maximum slump of **4 inches (102 mm)**, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I.
- H. Glazing: Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for **15-mil (0.4-mm)** dry film thickness per coat.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Comply with ANSI/SDI A250.8.

1. Design: **Flush panel**.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: R-value of not less than **6.0 deg F x h x sq. ft./Btu** (**1.057 K x sq. m/W**) when tested according to ASTM C 1363.
3. Vertical Edges for Single-Acting Doors: **Square edge**.
4. Top and Bottom Edges: Closed with flush or inverted **0.042-inch- (1.0-mm-)** thick, end closures or channels of same material as face sheets.
5. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Comply with ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), **Model 1 (Full Flush)**.

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet **unless metallic-coated sheet is indicated**. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), **Model 1 (Full Flush)**.

D. Hardware Reinforcement: ANSI/SDI A250.6.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as **knocked down** unless otherwise indicated.
3. Frames for Level 2 Steel Doors: **0.053-inch- (1.3-mm-)** thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet **unless metallic-coated sheet is indicated**.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as **knocked down** unless otherwise indicated.
3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
4. Frames for Level 2 Steel Doors: **0.053-inch- (1.3-mm-)** thick steel sheet.
5. Frames for Wood Doors: **0.053-inch- (1.3-mm-)** thick steel sheet.
6. Frames for Borrowed Lights: **Same as adjacent door frame**.

D. Hardware Reinforcement: ANSI/SDI A250.6.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, same material as door face sheet.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, same material as frames.
- D. Terminated Stops: Where indicated, terminate stops 6 inches (152 mm) above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.8 LOUVERS

A. Provide **sightproof** louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Fire-Rated Automatic Louvers: Movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated.

2.9 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Ceiling Struts: Minimum **1/4-inch-thick by 1-inch-** (6.4-mm-thick by 25.4-mm-) wide steel.
- C. Grout Guards: Formed from same material as frames, not less than **0.016 inch** (0.4 mm) thick.

2.10 FABRICATION

- A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- B. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- C. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. **Sidelight and Transom Bar** Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 - 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 6. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than **18 inches** (457 mm) from top and bottom of frame. Space anchors not more than **32 inches** (813 mm) o.c. and as follows:
 - 1) Two anchors per jamb up to **60 inches** (1524 mm) high.
 - 2) Three anchors per jamb from **60 to 90 inches** (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from **90 to 120 inches** (2286 to 3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than **18 inches** (457 mm) from top and bottom of frame. Space anchors not more than **32 inches** (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to **60 inches** (1524 mm) high.
 - 2) Four anchors per jamb from **60 to 90 inches** (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from **90 to 96 inches** (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each **24 inches** (610 mm) or fraction thereof above **96 inches** (2438 mm) high.

- 5) Two anchors per head for frames more than 42 inches (1066 mm) wide and mounted in metal-stud partitions.
 - c. Compression Type: Not less than two anchors in each jamb.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers.
- a. Single-Door Frames: Three door silencers.
 - b. Double-Door Frames: Two door silencers.
- D. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 electrical Sections.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow metal work.
 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.11 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
1. Shop Primer: ANSI/SDI A250.10.
- B. Factory-Applied Paint Finish: ANSI/SDI A250.3.
1. Color and Gloss: **As selected by Architect from manufacturer's full range.**

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.

- c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- B. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: **1/8 inch (3 mm)** plus or minus **1/16 inch (1.6 mm)**.
 - b. Between Edges of Pairs of Doors: **1/8 inch (3 mm)** plus or minus **1/16 inch (1.6 mm)**.
 - c. Between Bottom of Door and Top of Threshold: Maximum **3/8 inch (9.5 mm)**.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum **3/4 inch (19 mm)**.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors according to **NFPA 105** and **UBC Standard 7-2**.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than **9 inches (230 mm)** o.c. and not more than **2 inches (50 mm)** o.c. from each corner.

3.2 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

1.1 QUALITY ASSURANCE

- A. Quality Standard: **AWI**.

1.2 DOOR CONSTRUCTION, GENERAL

- A. Low-Emitting Materials: Made with adhesives and composite wood products that do not contain urea formaldehyde.
- B. WDMA I.S.1-A Performance Grade:
 - 1. Standard Duty.

1.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Semi Solid-Core Doors:
 - 1. Grade: **Economy (Grade B faces)**.
 - 2. Species: **White oak or as per local distributor's option match**.
 - 3. Cut: **Plain sliced (flat sliced) or as per local distributor's option match**.
 - 4. Match between Veneer Leaves: **As per local distributor's option match**.
 - 5. Assembly of Veneer Leaves on Door Faces: **Center-balance or as per local distributor's option match**.
 - 6. Core: **Either glued wood stave or structural composite lumber**
 - 7. Construction: **Five plies, bonded or as per local distributor's option**
 - 8. WDMA I.S.1-A Performance Grade: **Standard Duty or as per local distributor's option**.
- B. Interior Hollow-Core Doors:
 - 1. Grade: **Economy (Grade B faces)**.
 - 2. Species: **White oak or as per local distributor's option match**.
 - 3. Cut: **Plain sliced (flat sliced) or as per local distributor's option match**.
 - 4. Match between Veneer Leaves: **Center-balance or as per local distributor's option match**.
 - 5. Assembly of Veneer Leaves on Door Faces: **Center-balance or as per local distributor's option match**.
 - 6. Construction: **Seven plies or as per local distributor's option**
 - 7. WDMA I.S.1-A Performance Grade: **Standard Duty or as per local distributor's option**.

1.4 DOORS FOR OPAQUE FINISH

- A. Interior Semi Solid-Core Doors:
 - 1. Grade: **Economy**.
 - 2. Faces: **Any closed-grain hardwood of mill option**.
 - 3. Core: **Either glued wood stave or structural composite lumber**.
 - 4. Construction: **Five plies, bonded**.
 - 5. WDMA I.S.1-A Performance Grade: **Standard Duty or as per local distributor's option**.

1.5 LOUVERS AND LIGHT FRAMES

- A. Louvers: **Wood or Extruded aluminum with clear anodic finish or as per local distributor's option match.**

1.6 PRIMING/FINISHING

- A. Transparent Factory Finishes:

1. Grade: **Custom.**
2. Finish: **Conversion varnish.**
3. Effect: **Open-grain finish.**

- B. Opaque Factory Finishes:

1. Grade: **Custom.**
2. Finish: **Conversion varnish.**

END OF SECTION 081416

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

1.1 SUMMARY

- A. **Exterior and interior** storefront framing.
- B. Storefront framing for window walls.
- C. Storefront framing for ribbon walls.
- D. Storefront framing for punched openings.
- E. **Exterior and interior** manual-swing entrance doors **and door-frame units**.

1.2 QUALITY ASSURANCE

- A. Quality-control program for structural-sealant-glazed system.
- B. Preconstruction sealant testing.
- C. Mockups for each form of construction and finish.

1.3 WARRANTY

- A. Materials and Workmanship: **Two** years.
- B. Finish: **Two** years.

1.4 MATERIALS

- A. Aluminum: Alloy recommended by manufacturer.
- B. Steel reinforcement as required by manufacturer.

1.5 FRAMING SYSTEMS

- A. Framing Members: Manufacturer's standard extruded-aluminum framing members.
 - 1. Construction: **Nonthermal**.
 - 2. Glazing System: **As indicated on drawings**.
 - 3. Glazing Plane: **As indicated on drawings**.
- B. Fasteners and accessories.
- C. Concrete and masonry inserts.
- D. Framing system gaskets and sealants.

1.6 GLAZING SYSTEMS

- A. Glazing: As specified in Division 08 Section "Glazing."
- B. Glazing gaskets.
- C. Spacers and setting blocks.
- D. Bond-breaker tape.
- E. Glazing Sealants:
 - 1. Weatherseal sealant.

1.7 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors:
 - 1. Door Construction: **1-3/4-inch (44.5-mm)** overall thickness or as indicated on drawings.
 - 2. Door Design: **As indicated on drawings.**
 - 3. Glazing stops and gaskets.
- B. Entrance Door Hardware: **As indicated on drawings.**

1.8 ALUMINUM FINISHES

- A. Aluminum Finishes: **Class I, clear anodic.**

END OF SECTION 084113

SECTION 08710 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.
- B. This Section includes the following:
 - 1. Hinges.
 - 2. Lock cylinders and keys.
 - 3. Lock and latch sets.
 - 4. Bolts.
 - 5. Push/pull units.
 - 6. Closers.
 - 7. Protection plates.
 - 8. Weatherstripping for exterior doors.
 - 9. Astragals or meeting seals on pairs of doors.
 - 10. Thresholds.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 8 Section "Flush Wood Doors" for factory prefabricating and factory premachining of doors for door hardware.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
- B. Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size, and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.
 - h. Keying information.
 - 2. Submittal Sequence: Submit initial draft of final schedule along with essential product data in order to facilitate the fabrication of other work that is critical in the Project construction schedule. Submit final schedule after samples, product data, coordination with shop drawings of other work, delivery schedules, and similar information has been completed and accepted.
 - 3. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
- D. Samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.
 - 1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.
 - 1. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.
- C. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.5 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.6 MAINTENANCE

- 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Butts and Hinges:
 - a. Bommer Industries, Inc.
 - b. Cal-Royal Products, Inc.
 - c. Hager Hinge Co.
 - d. Lawrence Brothers, Inc.
 - e. McKinney Products Co.
 - f. Stanley Hardware, Div. Stanley Works.
 - 2. Cylinders and Locks:
 - a. Arrow Lock Manufacturing Co.
 - b. Best Lock Corp.
 - c. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
 - d. Falcon Lock Co.
 - e. Sargent Manufacturing Company.
 - f. Schlage Lock, Div. Ingersoll-Rand Door Hardware Group.

- g. Yale Security Inc
3. Bolts:
 - a. Builders Brass Works Corp.
 - b. Glynn-Johnson Corp.
 - c. Hager Hinge Co.
 - d. H. B. Ives, A Harrow Company.
 - e. Quality Hardware Mfg. Co., Inc.; Div. Newman Tonks, Inc.
 - f. Stanley Hardware, Div. Stanley Works.
 4. Push/Pull Units:
 - a. Baldwin Hardware Corp.
 - b. Brookline Industries, Div. Yale Security Inc.
 - c. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
 - d. Hager Hinge Co.
 - e. Hiawatha, Inc.
 - f. H. B. Ives, A Harrow Company.
 - g. Triangle Brass Manufacturing Company (Trimco).
 5. Overhead Closers:
 - a. Arrow Lock Manufacturing Co.
 - b. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
 - c. Dorma Door Controls International.
 - d. International Door Closers, Inc.
 - e. LCN, Div. Ingersoll-Rand Door Hardware Group.
 - f. Monarch Hardware & Mfg. Co., Div Newman Tonks, Inc.
 - g. Norton Door Controls, Div. Yale Security Inc.
 - h. Rixson-Firemark, Div. Yale Security Inc.
 - i. Sargent Manufacturing Company.
 - j. Yale Security Inc.
 6. Door Trim Units:
 - a. Baldwin Hardware Corp.
 - b. Brookline Industries, Div. Yale Security Inc.
 - c. Builders Brass Works Corp.
 - d. Hager Hinge Co.
 - e. Triangle Brass Manufacturing Company (Trimco).
 7. Kick, Mop, and Armor Plates:
 - a. Baldwin Hardware Corp.
 - b. Brookline Industries, Div. Yale Security Inc.
 - c. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
 - d. Hager Hinge Co.
 - e. Triangle Brass Manufacturing Company (Trimco).
 8. Bifold Door Hardware:
 - a. Grant Hardware Co.
 - b. P. C. Henderson Inc.
 - c. L. E. Johnson Products, Inc.
 - d. Stanley Hardware, Div. Stanley Works.
 9. Door Stripping and Seals:
 - a. Hager Hinge Co.
 - b. National Guard Products, Inc.
 - c. Pemko Manufacturing Co., Inc.
 10. Thresholds:
 - a. Hager Hinge Co.
 - b. National Guard Products, Inc.
 - c. Pemko Manufacturing Co., Inc.
 - d. Reese Enterprises, Inc.
 - e. Sealeze Corp.
 - f. Zero International, Inc.
 11. Astragals:
 - a. Hager Hinge Co.
 - b. National Guard Products, Inc.
 - c. Pemko Manufacturing Co., Inc.
 - d. Reese Enterprises, Inc.

2.2 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.
2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.
 - a. Butts and Hinges: ANSI/BHMA A156.1.
 - b. Bored and Preamsembled Locks and Latches: ANSI/BHMA A156.2.
 - c. Exit Devices: ANSI/BHMA A156.3.
 - d. Door Controls - Closers: ANSI/BHMA A156.4.
 - e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
 - f. Architectural Door Trim: ANSI/BHMA A156.6.
 - g. Template Hinge Dimensions: ANSI/BHMA A156.7.
 - h. Door Controls - Overhead Holders: ANSI/BHMA A156.8.
 - i. Interconnected Locks and Latches: ANSI/BHMA A156.12.
 - j. Mortise Locks and Latches: ANSI/BHMA A156.13.
 - k. Sliding and Folding Door Hardware: ANSI/BHMA A156.14.
 - l. Closer Holder Release Devices: ANSI/BHMA A156.15.
 - m. Auxiliary Hardware: ANSI/BHMA A156.16.
 - n. Self-Closing Hinges and Pivots: ANSI/BHMA A156.17.
 - o. Materials and Finishes: ANSI/BHMA A156.18.

2.3 MATERIALS AND FABRICATION

- A. Manufacturer's Name Plate: Do not use 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 acceptable to Architect.
 1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- B. Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.
- C. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
- E. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES, BUTTS, AND PIVOTS

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Screws: Provide Phillips flat-head screws complying with the following requirements:
 1. For metal doors and frames install machine screws into drilled and tapped holes.
 2. For wood doors and frames install wood screws.
 3. For fire-rated wood doors install #12 x 1-1/4-inch (32-mm), threaded-to-the-head steel wood screws.
 4. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Out-Swing Exterior Doors: Nonremovable pins.
2. Out-Swing Corridor Doors with Locks: Nonremovable pins.
3. Interior Doors: Nonrising pins.
4. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) indicated.

D. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors **90 inches (2250 mm)** or less in height and one additional hinge for each **30 inches (750 mm)** of additional height.

1. Fire-Rated Doors: Not less than 3 hinges per door leaf for doors **86 inches (2150 mm)** or less in height with same rule for additional hinges.

2.5 LOCK CYLINDERS AND KEYING

- A. Standard System: Except as otherwise indicated, provide new masterkey system for Project.
- B. Multiple-Building System: Except as otherwise indicated, provide new grandmasterkey system for Project.
- C. Equip locks with manufacturer's standard 6-pin tumbler cylinders.
- D. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
- E. Comply with Owner's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
 1. Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."
- F. Key Material: Provide keys of nickel silver only.
- G. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.

2.6 LOCKS, LATCHES, AND BOLTS

- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
- B. Lock Throw: Provide **5/8-inch (16-mm)** minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
 1. Provide **1/2-inch (13-mm)** minimum throw of latch for other bored and preassembled types of locks and **3/4-inch (19-mm)** minimum throw of latch for mortise locks. Provide **1-inch (25-mm)** minimum throw for all dead bolts.
- C. Flush Bolt Heads: Minimum of **1/2-inch- (13-mm-)** diameter rods of brass, bronze, or stainless steel with minimum **12-inch- (300-mm-)** long rod for doors up to **84 inches (2100 mm)** in height. Provide longer rods as necessary for doors exceeding **84 inches (2100 mm)** in height.

2.7 PUSH/PULL UNITS

- A. Concealed Fasteners: Provide manufacturer's special concealed fastener system for installation, thru-bolted for matched pairs but not for single units.

2.8 CLOSERS AND DOOR CONTROL DEVICES

- A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.
 1. Where parallel arms are indicated for closers, provide closer unit one size larger than recommended for use with standard arms.
 2. Provide parallel arms for all overhead closers, except as otherwise indicated.

- B. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.
- C. Combination Door Closers and Holders: Provide units designed to hold door in open position under normal usage and to release and close door automatically under fire conditions. Incorporate an integral electromagnetic holder mechanism designed for use with UL listed fire detectors, provided with normally closed switching contacts.
 - 1. Provide integral smoke detector device in combination door closers and holders complying with UL 228.
- D. Flush Floor Plates: Provide finished metal flush floor plates for floor closers except where thresholds are indicated and cover plate is specified to be an integral part of threshold. Finish floor plate to match hardware sets, unless otherwise indicated.

2.9 WEATHERSTRIPPING AND SEALS

- A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
- B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
- C. Weatherstripping at Jambs and Heads: Provide bumper-type resilient insert and metal retainer strips, surface applied unless shown as mortised or semimortised, and of following metal, finish, and resilient bumper material:
 - 1. Extruded aluminum with color anodized finish as selected from manufacturer's standard color range, 0.062-inch (1.6-mm) minimum thickness of main walls and flanges.
 - 2. Sponge neoprene conforming to MIL R 6130, Class II (Closed Cell).
 - a. Grade A: 30 to 150 deg F (-1 to 65 deg C), oil-resistant and self-extinguishing.
 - 3. Brush pile insert of polypropylene or nylon woven pile and aluminum strip backing complying with AAMA 701.2.
- D. Weatherstripping at Door Bottoms: Provide threshold consisting of contact-type resilient insert and metal housing of design and size shown and of following metal, finish, and resilient seal strip:
 - 1. Flexible vinyl wiper or sweep seal strip.
 - 2. Brush pile insert of polypropylene or nylon woven pile and aluminum strip backing complying with AAMA 701.2.

2.10 THRESHOLDS

- A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.
- B. Exterior Hinged or Pivoted Doors: Provide units not less than 4 inches (100 mm) wide, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames, and as follows:
 - 1. For in-swinging doors provide units with interlocking lip and interior drain channel; include hook on bottom edge of door and drain pan.
 - 2. For out-swinging doors provide units with interlocking lip and with hook on bottom edge of door to act as weather bar.

2.11 HARDWARE FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets).

- B. Provide finishes that match those established by BHMA or, if none established, match the Architect's sample.
- C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- D. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer."
- E. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.
- F. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.
 - 1. Rust-Resistant Finish: For iron and steel base metal required for exterior work and in areas shown as "High Humidity" areas (and also when designed with the suffix -RR), provide 0.2-mil- (0.005-mm-) thick copper coating on base metal before applying brass, bronze, nickel, or chromium plated finishes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
 - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
 - 2. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 7 Section "Joint Sealers."
- F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper

function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

- B. Clean adjacent surfaces soiled by hardware installation.
- C. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
- D. Six-Month Adjustment: Approximately six months after the date of Substantial Completion, the Installer, accompanied by representatives of the manufacturers of latchsets and locksets and of door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:
 - 1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
 - 2. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures.
 - 3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.
 - 4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

END OF SECTION 08710

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. INTERIOR VIEW Windows OR STORE FRONTS.
2. Doors SIDELIGHT.

1.3 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. 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 sealants or 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:
- 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.

1.5 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 and of 12-inch-long Samples for sealants. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- C. Samples: For the following products, in the form of 12-inch- square Samples for glass.
 1. Each color of tinted float glass.
 2. For each color (except black) of exposed glazing sealant indicated.
- D. 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.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

- F. 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.

1.6 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. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.
- C. Source Limitations for Tinted Glass: Obtain tinted, heat-absorbing, and light-reducing float glass from one primary-glass manufacturer for each tint color indicated.
- D. Source Limitations for Laminated Glass: Obtain laminated-glass units from one manufacturer using the same type of glass lites and interlayers for each type of unit indicated.
- E. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- F. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
 - 1. Sealant 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 glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- G. 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.
- H. 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" and "Laminated Glass Design Guide."
 - 2. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines," and SIGMA TB-3001, "Sloped Glazing Guidelines."

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.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

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.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work.

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. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
- B. Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.
- C. 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 LAMINATED GLASS

- A. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified, including those in the Laminated-Glass Schedule at the end of Part 3.
- B. Interlayer: Interlayer material as indicated below, clear or in colors, and 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.
 - 1. Interlayer Material: Polyvinyl butyral sheets.
- C. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets as follows:
 - 1. Laminate lites with polyvinyl butyral interlayer in autoclave with heat plus pressure.

2.5 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
 - 1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range for this characteristic.
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant in the Glazing Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

- C. Glazing Sealant for Fire-Resistive Glazing Products: Identical to product used in test assembly to obtain fire-protection rating.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. 6AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
 - 1. Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 GLAZING GASKETS

- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.
- B. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
 - 1. Neoprene, ASTM C 864.
 - 2. EPDM, ASTM C 864.
 - 3. Any material indicated above.
- C. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
 - 1. Neoprene.
 - 2. EPDM.
 - 3. Any material indicated above.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.9 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.

- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with indoor and outdoor faces.
- C. Grind smooth and polish exposed glass edges.

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, sealants, 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, and adequate sealant thicknesses, 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. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

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. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket 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. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

3.6 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.7 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.

END OF SECTION 08800

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes non-load-bearing steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

1.2 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. Sound Transmission Characteristics: For STC-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

- a. Type: Postinstalled, expansion anchor.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.
- D. Grid Suspension System for 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.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation;
 - c. Drywall Furring System.
 - d. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).
- B. Slip-Type Head Joints: Where indicated, provide the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 - 3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- C. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.
 - 1. Depth: 1-1/2 inches (38.1 mm).
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

2.4 AUXILIARY MATERIALS

- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

3.2 INSTALLING SUSPENSION SYSTEMS

A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

B. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
3. Do not attach hangers to steel roof deck.
4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

C. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb, unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch (12.7-mm)** clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of not less than 2 studs at ends of arcs, place studs **6 inches (150 mm)** o.c.
- C. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092613 - GYPSUM VENEER PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Gypsum veneer plaster and gypsum base for veneer plaster.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, fabrication, and installation of control joints, and reveals and trim; include plans, elevations, sections, details of components, and attachments to other work.
- C. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch (300-mm) length for each trim accessory.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain gypsum veneer plaster products, including gypsum base for veneer plaster, joint reinforcing tape, and embedding material, from a single manufacturer.
- B. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by a testing and inspecting agency.
- C. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- D. Mockups: Provide a full-thickness finish mockup for each type and finish of gypsum veneer plaster and substrate to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select representative surfaces and conditions for application of each type of gypsum veneer plaster and substrate.
 - 2. Apply gypsum veneer plaster, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 GYPSUM VENEER PLASTER MATERIALS

- A. One-Component Gypsum Veneer Plaster: ASTM C 587, formulated for application directly over substrate without use of separate base-coat material.
 - 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. G-P Gypsum; [Cameo] [DensArmor Cote Interior] Veneer Plaster.
 - b. National Gypsum Company; [Uni-Kal] [X-KALibur] Plaster.
 - c. USG Corporation; Diamond Interior Finish Plaster.

2.2 PANEL PRODUCTS

- A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.
- B. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- C. Gypsum Base for Veneer Plaster: ASTM C 588/C 588M.
 - 1. Moisture- and Mold-Resistant Base: With moisture- and mold-resistant core, glass-mat facing on both sides of panel, and 5/8-inch (16-mm) thick, Type X core.
 - a. Mold Resistance: ASTM D 3273; no mold growth after four weeks' exposure.
- D. Backing Panels for Multilayer Applications: ASTM C 588/C 588M gypsum base or ASTM C 36/C 36M gypsum board, as recommended by gypsum veneer plaster manufacturer, for application method and thicknesses indicated.
 - 1. Core: Matching face layer, unless otherwise indicated.
 - 2. Thickness: Matching face layer, unless otherwise indicated.

2.3 TRIM ACCESSORIES

- A. Standard Trim: ASTM C 1047, provided or approved by manufacturer for use in gypsum veneer plaster applications indicated.
 - 1. Material: Plastic.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.

- f. Curved-Edge Cornerbead: With notched or flexible flanges.
- g. Control joints.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 1. 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:
 - a. Fry Reglet Corporation.
 - b. Gordon Inc.
 - c. Pittcon Industries.

2.4 JOINT REINFORCING MATERIALS

A. General: Comply with joint strength requirements in ASTM C 587 and with gypsum veneer plaster manufacturer's written recommendations for each application indicated.

B. Joint Tape:

- 1. Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for applications indicated.

C. Embedding Material for Joint Tape:

- 1. Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for use with joint-tape material and gypsum veneer plaster applications indicated.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.

B. Bonding Agent: ASTM C 631, polyvinyl acetate.

C. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum base face-layer panels to backing-layer panels in multilayer construction.

- 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. 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 (0.84 to 2.84 mm) thick.

E. 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. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- 2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of <Insert number> percent by weight.

2.6 GYPSUM VENEER PLASTER MIXES

- A. Mechanically mix gypsum veneer plaster materials to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.

PART 3 - EXECUTION

3.1 INSTALLING PANELS, GENERAL

- A. Gypsum Base for Veneer Plaster: Apply according to ASTM C 844 unless manufacturer's written recommendations are more stringent.
 - 1. Do not allow gypsum base to degrade from exposure to sunlight as evidenced by fading of paper facing.
 - 2. Erection Tolerance: No more than **1/16-inch (1.6-mm)** offsets between planes of gypsum base panels, and **1/8 inch in 8 feet (3 mm in 2.4 m)** noncumulative, for level, plumb, warp, and bow.
- B. Install sound attenuation blankets before installing gypsum base for veneer plaster unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling 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 panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.6 mm)** 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 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 panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach panels to framing provided at openings and cutouts.
- H. Form control joints with space between edges of adjoining panels.
- I. Cover both sides of steel stud partition framing with panels in concealed spaces, including above ceilings, except in internally braced chases.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.74 sq. m)** in area.
 - 2. Fit panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut panels to fit profile formed by coffers, joists, and other structural members; allow **1/4- to 3/8-inch- (6.4- to 9.5-mm-)** wide joints; seal joints with acoustical sealant.

- J. Wood Framing: Install panels over wood framing, with "floating" internal corner construction. Do not attach panels across the flat grain of wide-dimension lumber, including floor joists and headers. "Float" panels over these members or provide control joints to counteract wood shrinkage.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- L. Fastener Spacing: Comply with ASTM C 844, manufacturer's written recommendations, and fire-resistance-rating requirements.
 - 1. Space screws a maximum of 12 inches (305 mm) o.c. along framing members for wall or ceiling application.

3.2 INSTALLING PANELS

- A. Install gypsum base panels for veneer plaster in the following locations:
 - 1. Moisture- and Mold-Resistant Base: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum base panels before wall panels, to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On walls, apply gypsum base panels vertically and parallel to framing, unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other walls higher than 30 feet (9.0 m), install gypsum base panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-furring, apply gypsum base panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
- C. Single-Layer Fastening Methods: Apply gypsum base panels to supports with steel drill screws.

3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install according to ASTM C 844 and in specific locations approved by Architect.
- C. Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, **unless otherwise indicated**.

3.4 INSTALLING JOINT REINFORCEMENT

- A. Gypsum Base for Veneer Plaster: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C 843 and with gypsum veneer plaster manufacturer's written recommendations.
- B. Abuse-Resistant Base: Reinforce joints between abuse-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- C. Impact-Resistant Base: Reinforce joints between impact-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.
- D. Moisture- and Mold-Resistant Base: Reinforce joints between moisture- and mold-resistant panels with joint tape and embedding material according to panel manufacturer's written recommendations.

3.5 GYPSUM VENEER PLASTERING

- A. Bonding Agent: Apply bonding agent on dry base panels according to gypsum veneer plaster manufacturer's written recommendations.
- B. Gypsum Veneer Plaster Application: Comply with ASTM C 843 and with veneer plaster manufacturer's written recommendations.
 - 1. Two-Component Gypsum Veneer Plaster:
 - a. Base Coat: Trowel apply base coat over substrate to uniform thickness of 1/16 to 3/32 inch (1.6 to 2.4 mm). Fill all voids and imperfections.
 - b. Finish Coat: Trowel apply finish-coat plaster over base-coat plaster to uniform thickness of 1/16 to 3/32 inch (1.6 to 2.4 mm).
 - 2. Where gypsum veneer plaster abuts only metal door frames, windows, and other units, groove finish coat to eliminate spalling.
 - 3. Do not apply veneer plaster to gypsum base if paper facing has degraded from exposure to sunlight. Before applying veneer plaster, use remedial methods to restore bonding capability to degraded paper facing according to manufacturer's written recommendations and as approved by Architect.
- C. Concealed Surfaces: Do not omit gypsum veneer plaster behind cabinets, furniture, furnishings, and similar removable items. Omit veneer plaster in the following areas where it will be concealed from view in the completed Work unless otherwise indicated.
- D. Gypsum Veneer Plaster Finish: Smooth-troweled finish, unless otherwise indicated.

3.6 PROTECTION

- A. Protect installed gypsum veneer plaster from damage from weather, condensation, construction, and other causes during remainder of the construction period.
- B. Remove and replace gypsum veneer plaster and gypsum base panels that are wet, moisture damaged, or mold damaged.

1. Indications that gypsum base panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that gypsum base panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092613

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.
 - 2. Exterior gypsum board for ceilings and soffits.
 - 3. Tile backing panels.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 RECYCLED CONTENT OF GYPSUM PANELS

- A. Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.

2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 1. 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:
 - a. American Gypsum Co.
 - b. BPB America Inc.
 - c. G-P Gypsum.
 - d. Lafarge North America Inc.
 - e. National Gypsum Company.
 - f. PABCO Gypsum.
 - g. Temple.
 - h. USG Corporation.
- B. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
 - 1. Core: 5/8 inch (15.9 mm), Type X.
 - 2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Plastic.
 - 2. Shapes:
 - a. Cornerbead.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.

- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. 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. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - 2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of **<Insert number>** percent by weight.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Moisture- and Mold-Resistant Type: As indicated on Drawings.

3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.

3.4 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. 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:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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. Quarry tile.
 - 3. Paver tile.
 - 4. Glazed wall tile.
 - 5. Stone thresholds installed as part of tile installations.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for monolithic slab finishes specified for tile substrates.
 - 2. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Division 9 Section "Portland Cement Plaster" for portland cement scratch coat over metal lath on wall surfaces.

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.
 - 3. Ramp Surfaces: Minimum 0.8.
- B. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C 627 that are representative of those indicated for this Project:
 - 1. Moderate: Passes cycles 1 through 10.

1.5 SUBMITTALS

- A. Product Data: For each type of tile, mortar, grout, and other products specified.
- B. Shop Drawings: For the following:
 - 1. Tile patterns and locations.
 - 2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. 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.

- D. 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.
- E. Samples for Verification: Of each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.
 - 1. Each type and composition of tile and for each color and texture required, at least 12 inches (300 mm) square, mounted on braced cementitious backer units, and with grouted joints using product complying with specified requirements and approved for completed work in color or colors selected by Architect.
 - 2. Full-size units of each type of trim and accessory for each color required.
 - 3. Stone thresholds in 6-inch (150-mm) lengths.
 - 4. Metal edge strips in 6-inch (150-mm) lengths.
- F. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- G. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.
- H. 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.
- I. Tile Test Reports: Indicate and interpret test results for compliance of special-purpose tile with specified requirements.
- J. 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.
- D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:
 - 1. Stone thresholds.
 - 2. Joint sealants.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the ceramic tile installation schedules at the end of this Section.
- B. Products: Subject to compliance with requirements, provide products indicated in the ceramic tile installation schedules at the end of this Section.
- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Tile Products:

- | | |
|----------------------------------|--|
| a. American Marrazzi Tile, Inc. | k. Laufen International, Inc. |
| b. American Olean Tile Company. | l. Lonestar Ceramics Company. |
| c. Buchtal Corporation USA. | m. Mannington Ceramic Tile. |
| d. Cerim-Floor Gres Ceramiche. | n. Metropolitan Ceramics. |
| e. Crossville Ceramics. | o. Monarch Tile, Inc. |
| f. Dal-Tile Corporation. | p. Quarry Tile Company. |
| g. Florida Tile Industries, Inc. | q. Seneca Tiles, Inc. |
| h. GranitiFiandre. | r. Summitville Tiles, Inc. |
| i. Interceramics, USA. | s. United States Ceramic Tile Company. |
| j. KPT, Inc. | |

2. Tile-Setting and -Grouting Materials:

- | | |
|-------------------------------------|------------------------------------|
| a. American Olean Tile Company. | g. Custom Building Products. |
| b. Atlas Minerals & Chemicals, Inc. | h. Dal-Tile Corporation. |
| c. Boiardi Products Corporation. | i. DAP, Inc. |
| d. Bonsal: W.R. Bonsal Company. | j. Laticrete International, Inc. |
| e. Bostik. | k. Mapei Corporation. |
| f. C-Cure Corporation. | l. Southern Grouts & Mortars, Inc. |
| | m. Summitville Tiles, Inc. |
| | n. TEC Incorporated. |

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.
1. Where tile is indicated for installation in swimming pools, on exteriors, or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for these kinds of installations and has a record of successful in-service performance.

2.3 TILE PRODUCTS

- A. Unglazed Quarry Tile: Provide square-edged flat tile complying with the following requirements:
1. Wearing Surface: Abrasive aggregate embedded in surface.
 2. Facial Dimensions: 6 by 6 inches (152 by 152 mm).
 3. Thickness: 3/4 inch (19 mm).
 4. Face: Plain.
- B. Unglazed Paver Tile: Provide flat tile complying with the following requirements:
1. Composition: Natural clay.
 2. Facial Dimensions: 12 by 12 inches.
 3. Thickness: 1/2 inch (12.7 mm).
 4. Face: Plain with square edges.
- C. Glazed Wall Tile: Provide flat tile complying with the following requirements:
1. Module Size: 4-1/4 by 4-1/4 inches (108 by 108 mm).
 2. Thickness: 5/16 inch (8 mm).
 3. Face: Pattern of design indicated, with manufacturer's standard edges.
 4. Mounting: Factory back-mounted.
- D. 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. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above.
 - d. External Corners for Thin-Set Mortar Installations: Surface bullnose.

- e. Internal Corners: Field-butt square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.

2.4 STONE THRESHOLDS

- A. General: Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.
 - 1. Fabricate thresholds to heights indicated, but not more than 1/2 inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.
- B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and with a minimum abrasive-hardness value of 10 per ASTM C 241.
 - 1. Match Architect's sample for color and finish.

2.5 SETTING MATERIALS

- A. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A108.1A and as specified below:
 - 1. Cleavage Membrane: Asphalt felt, ASTM D 226, Type I (No. 15), or polyethylene sheeting ASTM D 4397, 4.0 mils (0.1 mm) thick.
 - 2. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A 185 and ASTM A 82, except for minimum wire size.
 - 3. Latex additive (water emulsion) described below, serving as replacement for part or all of gaging water, of type specifically recommended by latex additive manufacturer for use with job-mixed portland cement and aggregate mortar bed.
 - a. Latex Additive: Manufacturer's standard.
- B. Dry-Set Portland Cement Mortar: ANSI A118.1.
 - 1. For wall applications, provide nonsagging, latex-portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.
- C. 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.
 - a. For wall applications, provide nonsagging, latex-portland cement mortar complying with ANSI A118.4 for mortar of this type defined in Section F-2.1.2.
- D. Medium-Bed, Latex-Portland Cement Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:
 - 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. Mixture of Dry-Mortar Mix and Latex Additive: Mixture of prepackaged dry-mortar mix and liquid-latex additive complying with the following requirements:
 - a. Latex Additive: Styrene butadiene rubber.

2.6 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 1/8 inch (3.2 mm) and narrower.
 - b. Sanded grout mixture for joints 1/8 inch (3.2 mm) and wider.
2. Mixture of Dry-Grout Mix and Latex Additive: Mixture of factory-prepared, dry-grout mix and latex additive complying with the following requirements:
 - a. Unsanded Dry-Grout Mix: Dry-set grout complying with ANSI A118.6 for materials described in Section H-2.3, for joints 1/8 inch (3.2 mm) and narrower.
 - b. Sanded Dry-Grout Mix: Commercial portland cement grout complying with ANSI A118.6 for materials described in Section H-2.1, for joints 1/8 inch (3.2 mm) and wider.
 - c. Latex Additive: Styrene butadiene rubber.

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. Metal Edge Strips: White-zinc-alloy terrazzo strips, 1/8 inch (3.2 mm) wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.
- C. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.
 1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.
- D. 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.

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.
- B. 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. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.
 1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. 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.
 2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."

3.4 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: 1/16 inch (1.6 mm).
 - 2. Quarry Tile: 3/8 inch (9.5 mm).
 - 3. Paver Tile: 1/4 inch (6.35 mm).
- C. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
 - 1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.
- D. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.5 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. Install metal lath and scratch coat to walls to comply with ANSI A108.1A, Section 4.1.
- C. Joint Widths: Install tile on walls with the following joint widths:
 - 1. Wall Tile: 1/16 inch (1.6 mm).
- D. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
 - 1. Exterior tile wall installations.
 - 2. Tile wall installations in wet areas, including showers, tub enclosures, laundries, and swimming pools.
 - 3. Tile installed with chemical-resistant mortars and grouts.
 - 4. Tile wall installations composed of tiles 8 by 8 inches (203 by 203 mm) or larger.

3.6 CLEANING 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. 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.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09310

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Drawn to scale and coordinating acoustical panel ceiling installation with hanger attachment to building structure and ceiling mounted items:
- C. Samples: For each exposed finish.
- D. Product test reports.
- E. Research/evaluation reports.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory or an NVLAP-accredited laboratory.
- B. Fire-Test-Response Characteristics:
 - 1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 2. Surface-Burning Characteristics: Acoustical panels complying with ASTM E 1264 for Class **A** materials, when tested per ASTM E 84.
 - a. Smoke-Developed Index: 50 or less.
- C. Seismic Standard: Comply with the following:
 - 1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
 - 2. CISCA's Recommendations for Acoustical Ceilings: Comply with CISCA's "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2."

3. 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."
 4. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
 5. ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Preinstallation Conference: Conduct conference at **Project site**.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Acoustical Ceiling Panels: Full-size panels equal to **5.0** percent of quantity installed.
 2. Suspension System Components: Quantity of each exposed component equal to **2.0** percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Acoustical Panel Standard: Comply with ASTM E 1264.
1. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of **50** percent by weight.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
1. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than **25** percent.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: **Expansion** anchors fabricated from corrosion-resistant materials, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **five** times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching

hangers of type indicated, and with capability to sustain, without failure, a load equal to **10** times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

- D. Wire Hangers, Braces, and Ties: Zinc-coated carbon-steel wire; ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 1. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than **0.106-inch- (2.69-mm-)** diameter wire.
- E. Seismic perimeter stabilizer bars, seismic struts, and seismic clips.
- F. Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING: See drawing designation.

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.;
 - 2. BPB USA;
 - 3. Chicago Metallic Corporation;
 - 4. Ecophon CertainTeed, Inc.;
 - 5. Tectum Inc.;
 - 6. USG Interiors, Inc.
- C. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:
- D. Classification: Provide **fire-resistance-rated** panels complying with ASTM E 1264 for type and form as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form **1, nodular** .
- E. Color: **White**.
- F. LR: Not less than **.86**.
- G. NRC: Not less than **.70**, Type E-400 mounting per ASTM E 795.
- H. CAC: Not less than **35**.
- I. Edge/Joint Detail: **Shadowline edge detail by USG Interiors, Inc.**
- J. Thickness: **3/4 inch (19 mm)**.

- K. Modular Size: **24 by 24 inches** (610 by 610 mm).

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING: See drawing designation.

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.;
 2. BPB USA;
 3. Chicago Metallic Corporation;
 4. Ecophon CertainTeed, Inc.;
 5. USG Interiors, Inc.
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings > or a comparable product by one of the following:
- D. Double-Web, **Fire-Rated** 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, not less than **G30 (Z90)** coating designation, with prefinished **15/16-inch- (24-mm-)** wide metal caps on flanges.
1. Structural Classification: **Intermediate** duty system.
 2. End Condition of Cross Runners: **Override (stepped) or butt-edge** type.
 3. Cap Material: **Aluminum** cold-rolled sheet.
 4. Cap Finish: **Painted white**.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with **ASTM C 636**, **UBC Standard 25-2** and seismic design requirements indicated, per manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders.
- C. Suspend ceiling hangers from building's structural members, plumb and free from contact with insulation or other objects within ceiling plenum. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers, use trapezes or equivalent devices. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
1. Do not support ceilings directly from permanent metal forms or floor deck; anchor into concrete slabs.
 2. Do not attach hangers to steel deck tabs.

- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

END OF SECTION 095113

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.
 - 2. Resilient stair accessories.
 - 3. Resilient flooring accessories.
- B. Related Sections include the following:
 - 1. Division 9 Section "Resilient Tile Flooring."

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. Samples for Verification: In manufacturer's standard sizes, but not less than 12 inches (300 mm) long, of each product color and pattern specified.
- D. 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 (10 and 32 deg C).
- 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 deg F (21 deg C) or more than 95 deg F (35 deg C) 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 F (13 deg C) or more than 95 deg F (35 deg C).
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. For resilient products installed on traffic surfaces, close spaces to traffic during installation and for time period after installation recommended in writing by manufacturer.
- D. 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 (3 linear m) for each 500 linear feet (150 linear m) 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.
- B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation 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.
- B. Vinyl Wall Base: Products complying with FS SS-W-40, Type II and with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.3 RESILIENT STAIR ACCESSORIES

- A. Rubber Stair Treads: Products of style suitable for use indicated and complying with FS RR-T-650, Composition A and with requirements specified in the Resilient Wall Base and Accessory Schedule.
- B. Vinyl Stair Treads: Products of style suitable for use indicated and complying with FS RR-T-650, Composition B and with requirements specified in the Resilient Wall Base and Accessory Schedule.
- C. Risers: Products of same manufacturer as stair treads and complying with requirements specified in the Resilient Wall Base and Accessory Schedule.
- D. Stringers: Products of same manufacturer as stair treads and complying with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.

- C. 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. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Use stair-tread-nose filler, according to resilient tread manufacturer's written instructions, to fill nosing substrates that do not conform to tread contours.
- D. 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.
- E. 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. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 5. 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.
- 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.
- D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

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.
1. Apply protective floor polish to vinyl resilient products installed on floors and stairs that are free from soil, visible adhesive, and surface blemishes, if recommended by manufacturer.
 - a. Use commercially available product acceptable to resilient product manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
 2. Cover resilient products installed on floors and stairs with undyed, untreated building paper until inspection for Substantial Completion.
- 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.
1. Before cleaning, strip protective floor polish that was applied to vinyl products on floors and stairs after completing installation only if required to restore polish finish and if recommended by resilient product manufacturer.
 2. After cleaning, reapply polish on vinyl products on floors and stairs to restore protective floor finish according to resilient product manufacturer's written recommendations. Coordinate with Owner's maintenance program.

END OF SECTION 09653

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes modular carpet tile.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Shop Drawings: Show the following:
 - 1. Existing flooring materials to be removed.
 - 2. Existing flooring materials to remain.
 - 3. Carpet tile type, color, and dye lot.
 - 4. Pattern of installation.
 - 5. Insets and borders.
 - 6. Edge, transition, and other accessory strips.
 - 7. Transition details to other flooring materials.
- C. Samples: For each color and texture required.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and other Accessory Stripping: **12-inch-** (300-mm-) long Samples.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Mockups: Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles 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 tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.6 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs and delamination.
 - 1. Warranty Period: **[10]** years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to **[5]** percent of amount installed for each type indicated, but not less than **10 sq. yd. (8.3 sq. m).**

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. AS NOTED ON CONSTRUCTION DRAWINGS.
 - a. Color: **[As selected by Architect from manufacturer's full range]**
 - b. Pattern: **[Match Architect's samples].**

- C. Pile Thickness: for finished carpet tile[**per ASTM D 6859**].
- D. Primary Backing/Backcoating: [**Manufacturer's standard composite materials**]
- E. Secondary Backing: [**Manufacturer's standard material**]
- F. Size: As noted on drawings.
- G. Applied Soil-Resistance Treatment: [**Manufacturer's standard material**].
- H. Antimicrobial Treatment: [**Manufacturer's standard material**].
- I. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- J. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: [**As recommended in writing by carpet tile manufacturer**].
- C. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- D. Install pattern parallel to walls and borders.

END OF SECTION 096813

SECTION 098413

FIXED SOUND-ABSORPTIVE PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes acoustical wall panels.

1.3 DEFINITIONS

- A. NRC: Noise reduction coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of panel edge, core material, and mounting indicated.
- B. Shop Drawings: For acoustical wall panels. Include mounting devices and details. Include elevations showing panel sizes and direction of fabric weave and pattern matching. Indicate panel edge and core materials.
- C. Samples for Verification: For the following products. Prepare Samples from same material to be used for the Work.
 - 1. 12" sample of acoustical panel.
 - 2. Samples of fabric selection.
- D. Qualification Data: Acoustical system shall be installed only by an approved acoustical contractor.
- E. Maintenance Data: For acoustical wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain acoustical wall panels through one source from a single manufacturer.

- B. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 or another testing and inspecting agency acceptable to authorities having jurisdiction:

- 1. Flame-Spread Index: 25.
- 2. Smoke-Developed Index: 450.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and acoustical wall panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
- C. Protect panel edges from crushing and impact.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels 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.
- B. Field Measurements: Verify locations of acoustical wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical wall panels that fail in performance, materials, or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 ACOUSTICAL WALL PANEL

- A. Basis-of-Design Product:
 - 1. Panels shall be fabric-wrapped tectum panel, 1-1/2" thick (nominal).
 - 2. Edge detail to be fabric returned at edges to back.
 - 3. Edge profile: Kerfed
 - 4. Width and Height: As shown on drawings.
 - 5. Pattern as shown on drawings.

- a. Colors as selected by Architect from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, substrates, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of acoustical wall panels.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical wall panels in accordance with the pattern as shown on the drawings.
- B. Comply with acoustical wall panel manufacturer's written instructions for installation of panels using type of concealed mounting accessories indicated or, if not indicated, as recommended by manufacturer. Anchor panels securely to supporting substrate.

3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace acoustical wall panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 098413

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Aluminum (not anodized or otherwise coated).
 - 6. Wood.
 - 7. Plastic trim fabrications.
 - 8. Exterior portland cement (stucco).
 - 9. Exterior gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

- A. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional **10** percent, but not less than **5 gal.** of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: **As selected by Architect from manufacturer's full range.**

2.2 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of **E2**.

2.3 PRIMERS/SEALERS

A. Alkali-Resistant Primer: MPI #3.

1. VOC Content: E Range of **E1**.

B. Bonding Primer (Water Based): MPI #17.

1. VOC Content: E Range of **E1**.

C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint system indicated.

2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of **E1**.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of **E1**.

C. Cementitious Galvanized-Metal Primer: MPI #26.

1. VOC Content: E Range of E1.

D. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of **E1**.
2. Environmental Performance Rating: **EPR 1**.

2.5 WOOD PRIMERS

A. Exterior Latex Wood Primer: MPI #6.

1. VOC Content: E Range of **E1**.

B. Exterior Alkyd Wood Primer: MPI #5.

1. VOC Content: E Range of **E2**.

C. Exterior Oil Wood Primer: MPI #7.

1. VOC Content: E Range of E2.

2.6 EXTERIOR LATEX PAINTS

A. Exterior Latex (Flat): MPI #10 (Gloss Level 1).

1. VOC Content: E Range of **E1**.

B. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).

1. VOC Content: E Range of **E1**.

C. Exterior Latex (Gloss): MPI #119 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).

1. VOC Content: E Range of **E1**.

2.7 EXTERIOR ALKYD PAINTS

A. Exterior Alkyd Enamel (Flat): MPI #8 (Gloss Level 1).

1. VOC Content: E Range of E1.

B. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

1. VOC Content: E Range of **E1**.

C. Exterior Alkyd Enamel (Gloss): MPI #9 (Gloss Level 6).

1. VOC Content: E Range of **E1**.

2.8 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 - 1. VOC Content: E Range of **E1**.
- B. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
 - 1. VOC Content: E Range of **E1**.

2.9 TEXTURED AND HIGH-BUILD COATINGS

- A. Latex Stucco and Masonry Textured Coating: MPI #42.
 - 1. VOC Content: E Range of **E2**.
- B. High-Build Latex (Exterior): MPI #40.
 - 1. VOC Content: E Range of **E1**.

2.10 ALUMINUM PAINT

- A. Aluminum Paint: MPI #1.
 - 1. VOC Content: E Range of **E1**.

2.11 FLOOR COATINGS

- A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
 - 1. VOC Content: E Range of **E1**.
- B. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.
 - 1. VOC Content: E Range of **E1**.
- C. Interior/Exterior Latex Floor and Porch Paint (Low Gloss): MPI #60 (maximum Gloss Level 3).
 - 1. VOC Content: E Range of **E2**.
 - 2. Environmental Performance Rating: EPR 3.
- D. Exterior/Interior Alkyd Floor Enamel (Gloss): MPI #27 (Gloss Level 6).
 - 1. VOC Content: E Range of **E1**.
 - 2. Additives: Manufacturer's standard additive to increase skid resistance of painted surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Wood: 15 percent.
 - 3. Plaster: 12 percent.
 - 4. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 EXTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Latex System: MPI EXT 3.1A.
 - a. Prime Coat: Exterior latex matching topcoat.

- b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.
- 2. Latex Aggregate/Latex System: MPI EXT 3.1 B.
 - a. Prime Coat: Latex stucco and masonry textured coating.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.
- 3. Latex Over Alkali-Resistant Primer System: MPI EXT 3.1K.
 - a. Prime Coat: Alkali-resistant primer.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.
- 4. High-Build Latex System: MPI EXT 3.1L, applied to form dry film thickness of not less than **10 mils** (0.25 mm).
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: High-build latex (exterior).
- 5. Latex Aggregate System: MPI EXT 3.1N.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Latex stucco and masonry textured coating.

B. Concrete Substrates, Traffic Surfaces:

- 1. Latex Floor Paint System: MPI EXT 3.2A.
 - a. Prime Coat: Interior/exterior latex floor and porch paint (low gloss).
 - b. Intermediate Coat: Interior/exterior latex floor and porch paint (low gloss).
 - c. Topcoat: Interior/exterior latex floor and porch paint (low gloss).
- 2. Alkyd Floor Enamel System: MPI EXT 3.2D.
 - a. Prime Coat: Exterior/interior alkyd floor enamel (gloss).
 - b. Intermediate Coat: Exterior/interior alkyd floor enamel (gloss).
 - c. Topcoat: Exterior/interior alkyd floor enamel (gloss).
- 3. Clear Sealer System: MPI EXT 3.2G.
 - a. Prime Coat: Interior/exterior clear concrete floor sealer (solvent based).
 - b. Intermediate Coat: Interior/exterior clear concrete floor sealer (solvent based).
 - c. Topcoat: Interior/exterior clear concrete floor sealer (solvent based).
- 4. Water-Based Clear Sealer System: MPI EXT 3.2H.
 - a. Prime Coat: Interior/exterior clear concrete floor sealer (water based).
 - b. Intermediate Coat: Interior/exterior clear concrete floor sealer (water based).

- c. Topcoat: Interior/exterior clear concrete floor sealer (water based).

C. CMU Substrates:

1. Latex System: MPI EXT 4.2A.
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.
2. Latex Over Alkali-Resistant Primer System: MPI EXT 4.2L.
 - a. Prime Coat: Alkali-resistant primer.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.
3. High-Build Latex System: MPI EXT 4.2K, applied to form dry film thickness of not less than **10 mils (0.25 mm)**.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: High-build latex (exterior).
4. Latex Aggregate System: MPI EXT 4.2B.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Latex stucco and masonry textured coating.

D. Steel Substrates:

1. Quick-Drying Enamel System: MPI EXT 5.1A.
 - a. Prime Coat: Quick-drying alkyd metal primer.
 - b. Intermediate Coat: Quick-drying enamel matching topcoat.
 - c. Topcoat: Quick-drying enamel **semigloss**.
2. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel **semigloss**.
3. Aluminum Paint System: MPI EXT 5.1K.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Aluminum paint.
 - c. Topcoat: Aluminum paint.

E. Galvanized-Metal Substrates:

1. Latex System: MPI EXT 5.3A.

- a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **semigloss**.
 - 2. Latex Over Water-Based Primer System: MPI EXT 5.3H.
 - a. Prime Coat: Waterborne galvanized-metal primer.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **semigloss**.
 - 3. Alkyd System: MPI EXT 5.3B.
 - a. Prime Coat: Cementitious galvanized-metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel **semigloss**.
- F. Aluminum Substrates:
- 1. Latex System: MPI EXT 5.4H.
 - a. Prime Coat: Quick-drying primer for aluminum.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **semigloss**.
 - 2. Alkyd System: MPI EXT 5.4F.
 - a. Prime Coat: Quick-drying primer for aluminum.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel **semigloss**.
- G. Plastic Trim Fabrication Substrates:
- 1. Latex System: MPI EXT 6.8A.
 - a. Prime Coat: Bonding primer **water based**.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **semigloss**.
 - 2. Alkyd System: MPI EXT 6.8B.
 - a. Prime Coat: Bonding primer **water based**.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel **flat**.
- H. Stucco Substrates:
- 1. Latex System: MPI EXT 9.1A.
 - a. Prime Coat: Exterior latex matching topcoat.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.

2. Latex Over Alkali-Resistant Primer System: MPI EXT 9.1J.
 - a. Prime Coat: Alkali-resistant primer.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.
 3. High-Build Latex System: MPI EXT 9.1H, applied to form dry film thickness of not less than **10 mils** (0.25 mm).
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: High-build latex (exterior).
- I. Exterior Gypsum Board Substrates:
1. Latex System: MPI EXT 9.2A.
 - a. Prime Coat: Exterior latex matching topcoat.
 - b. Intermediate Coat: Exterior latex matching topcoat.
 - c. Topcoat: Exterior latex **flat**.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Wood.
 - 6. Gypsum board.
 - 7. Plaster.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.

1.3 QUALITY ASSURANCE

- A. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than **5 gal. (19 L)** of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 - 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 - 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - 4. Floor Coatings: VOC not more than 100 g/L.
 - 5. Shellacs, Clear: VOC not more than 730 g/L.
 - 6. Shellacs, Pigmented: VOC not more than 550 g/L.
 - 7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 - 8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 - 9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - 10. Floor Coatings: VOC not more than 100 g/L.
 - 11. Shellacs, Clear: VOC not more than 730 g/L.
 - 12. Shellacs, Pigmented: VOC not more than 550 g/L.
 - 13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 - 14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
 - 15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
 - 16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 - 1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.

- b. Acrylonitrile.
- c. Antimony.
- d. Benzene.
- e. Butyl benzyl phthalate.
- f. Cadmium.
- g. Di (2-ethylhexyl) phthalate.
- h. Di-n-butyl phthalate.
- i. Di-n-octyl phthalate.
- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

D. Colors: As selected by Owners' Colorist.

2.2 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

- 1. VOC Content: E Range of [E1] [E2] [E3].
- 2. Environmental Performance Rating: [EPR 1] [EPR 2] [EPR 3].

B. Interior Alkyd Primer/Sealer: MPI #45.

- 1. VOC Content: E Range of [E1] [E2].

C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.3 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

- 1. VOC Content: E Range of [E1] [E2].

B. Quick-Drying Alkyd Metal Primer: MPI #76.

- 1. VOC Content: E Range of [E1] [E2] [E3].

- C. Rust-Inhibitive Primer (Water Based): MPI #107.
 - 1. VOC Content: E Range of [E1] [E2] [E3].
 - 2. Environmental Performance Rating: [EPR 1] [EPR 2] [EPR 3].
- D. Cementitious Galvanized-Metal Primer: MPI #26.
 - 1. VOC Content: E Range of E1.
- E. Waterborne Galvanized-Metal Primer: MPI #134.
 - 1. VOC Content: E Range of [E1] [E2] [E3].
 - 2. Environmental Performance Rating: [EPR 1] [EPR 2] [EPR 3].
- F. Vinyl Wash Primer: MPI #80.
 - 1. VOC Content: E Range of [E2] [E3].
- G. Quick-Drying Primer for Aluminum: MPI #95.
 - 1. VOC Content: E Range of [E1] [E2] [E3].

2.4 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.
 - 1. VOC Content: E Range of [E1] [E2] [E3].
 - 2. Environmental Performance Rating: [EPR 1] [EPR 2] [EPR 3].

2.5 LATEX PAINTS

- A. Interior Latex (Low Sheen): MPI #44 (Gloss Level 2).
 - 1. VOC Content: E Range of [E1] [E2] [E3].
 - 2. Environmental Performance Rating: [EPR 1] [EPR 2] [EPR 3].
- B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
 - 1. VOC Content: E Range of [E1] [E2] [E3].
 - 2. Environmental Performance Rating: [EPR 1] [EPR 2] [EPR 3].
- C. Interior Latex (Satin): MPI #43 (Gloss Level 4).
 - 1. VOC Content: E Range of [E1] [E2] [E3].
 - 2. Environmental Performance Rating: [EPR 1.5] [EPR 2] [EPR 2.5] [EPR 3.5].
- D. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
 - 1. VOC Content: E Range of [E1] [E2] [E3].
 - 2. Environmental Performance Rating: [EPR 2] [EPR 3] [EPR 4].
 - 3. Environmental Performance Rating: [EPR 2] [EPR 3] [EPR 4].

2.6 ALKYD PAINTS

- A. Interior Alkyd (Eggshell): MPI #51 (Gloss Level 3).
 - 1. VOC Content: E Range of [E1] [E2].
- B. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
 - 1. VOC Content: E Range of [E1] [E2].
 - 2. Environmental Performance Rating: [EPR 1] [EPR 2] [EPR 3].

2.7 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
 - 1. VOC Content: E Range of [E1] [E2] [E3].

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- E. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- F. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 INTERIOR PAINTING SCHEDULE

- 1. As selected by Owners' Colorist.

END OF SECTION 099123

SECTION 211313 - WET-PIPE SPRINKLER 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 specifies standpipe and wet-pipe sprinkler systems for buildings and structures.
- B. Products specified in this Section with installation not in Contract include sprinkler cabinets with spare sprinklers and sprinkler wrenches. Deliver to the Owner's maintenance personnel.
- C. Products installed but not specified in this Section include water meters that will be furnished by the utility company to the site and ready for installation. This is the name and address of the utility company:

1.3 DEFINITIONS

- A. Working plans as used in this Section refer to documents (including drawings and calculations) prepared pursuant to requirements in NFPA 13 for obtaining approval of authority having jurisdiction.
- B. Other definitions for fire protection systems are included in referenced NFPA standards.

1.4 SYSTEM DESCRIPTION

- A. Wet-Pipe Sprinkler System: System with automatic sprinklers attached to piping system containing water and connected to water supply so that water discharges immediately from sprinklers when they are opened by fire.
- B. Sprinkler System Protection Limits: All spaces within areas indicated. Include closets, toilet and locker room areas, each landing of each stair, and special applications areas.
 - 1. Exception: Areas with other fire extinguishing systems and areas indicated to be without sprinkler protection.
 - 2. Exception: Light-hazard occupancy, dwelling unit bathrooms 55 sq. ft. and less and closets 24 sq. ft. and less, that also comply with other NFPA 13 requirements.
- C. Standpipe Systems: Systems that are wet type have water supply valve open and pressure maintained at all times and include branches extending from standpipes to sprinkler zone valves.
- D. Class I, Standpipe and Hose System: Arrangement of piping, valves, hose connections, hose, and accessories for use by persons trained in use of heavy fire streams. Valves are 2-1/2-inch size.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design and obtain approval from authority having jurisdiction for fire protection systems specified.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- B. Minimum Pipe Sizes: Not smaller than sizes indicated for connection to water supply piping, standpipes, and branches from standpipes to sprinklers.
- C. Conduct fire hydrant flow tests as required to obtain hydraulic data needed to prepare design for hydraulically calculated systems.
- D. Hydraulically design sprinkler systems according to:
 - 1. Sprinkler System Occupancy Hazard Classifications: As follows:
 - a. Office and Public Areas: Light hazard.
 - b. Storage Areas: Ordinary hazard.
 - c. Equipment Rooms: Ordinary hazard.
 - d. Service Areas: Ordinary hazard.
 - 2. Minimum Density Requirements for Automatic Sprinkler System Hydraulic Design: As follows:
 - a. Light Hazard Occupancy: 0.10 GPM over 1500 sq. ft. area.
 - b. Ordinary Hazard, Group 1 Occupancy: 0.15 GPM over 1500 sq. ft. area.
 - c. Ordinary Hazard, Group 2 Occupancy: 0.20 GPM over 1500 sq. ft. area.
 - d. Extra Hazard, Group 1 Occupancy: 0.30 GPM over 2500 sq. ft. area.
 - e. Extra Hazard, Group 2 Occupancy: 0.40 GPM over 2500 sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authority having jurisdiction.
 - 3. Maximum Sprinkler Spacing: As follows:
 - a. Office Space: 120 sq. ft./sprinkler.
 - b. Storage Areas: 130 sq. ft./sprinkler.
 - c. Mechanical Equipment Rooms: 130 sq. ft./sprinkler.
 - d. Electrical Equipment Rooms: 130 sq. ft./sprinkler.
 - e. Other Areas: According to NFPA 13.
- E. Components and Installation: Capable of producing piping systems with the following minimum working pressure ratings except where indicated otherwise.
 - 1. Sprinkler Systems: 175 psig.
 - 2. Standpipe and Hose Systems: 175 psig.

1.6 SUBMITTALS

- A. Product data for fire protection system components. Include the following:
 - 1. Water meters.
 - 2. Backflow preventers.
 - 3. Valves.
 - 4. Specialty valves, accessories, and devices.
 - 5. Alarm devices. Include electrical data.
 - 6. Fire department connections. Include type of fire department connection; number, size, type, and arrangement of inlets; size and direction of outlet; and finish.
 - 7. Hose valves. Include size, type, and finish.
 - 8. Hose valves and racks, hoses, and nozzles. Include size, type, and finish of hose valves; type and length of hoses; finish of hose couplings; type, material, and finish of nozzles; and finish of rack.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

9. Excess pressure pumps. Include electrical data.
 10. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other data.
- B. Sprinkler system drawings identified as "working plans," prepared according to NFPA 13. Submit required number of sets to authority having jurisdiction for review, comment, and approval. Include system hydraulic calculations where applicable.
 - C. Licensed engineer's sprinkler system drawings specified in "Quality Assurance" Article to authority having jurisdiction. Include system hydraulic calculations where applicable.
 - D. Sprinkler system drawings, identified as "working plans" and prepared according to NFPA 13, that have been approved by authority having jurisdiction. Include system hydraulic calculations where applicable.
 - E. Licensed engineer's installation report specified in "Field Quality Control" Article.
 - F. Test reports and certificates as described in NFPA 13. Include "Contractor's Material & Test Certificate for Aboveground Piping" and "Contractor's Material & Test Certificate for Underground Piping."
 - G. Maintenance data for each type of fire protection specialty specified, for inclusion in Operating and Maintenance Manual specified in Division 1 Section "Project Closeout."
 - H. 2 copies of NFPA 13A "Recommended Practice for the Inspection, Testing and Maintenance of Sprinkler Systems." Deliver to Owner's maintenance personnel.
 - I. 2 copies of NFPA 14A "Recommended Practice for the Inspection, Testing and Maintenance of Standpipe and Hose Systems." Deliver to Owner's maintenance personnel.
 - J. 2 copies of NFPA 25 "Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems." Deliver to Owner's maintenance personnel.
 - K. 2 copies of NFPA 1962 "Standard for the Care, Use, and Service Testing of Fire Hose Including Couplings and Nozzles." Deliver to Owner's maintenance personnel.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL Fire Protection Equipment Directory and FM Approval Guide and that conform to other requirements indicated.
 - B. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.
 - C. Listing and Labeling: Equipment, specialties, and accessories that are listed and labeled.
 1. The Terms "Listed" and "Labeled": As defined in "National Electrical Code," Article 100.
 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
 - D. Comply with requirements of authority having jurisdiction for submittals, approvals, materials, hose threads, installation, inspections, and testing.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- E. Comply with requirements of Owner's insurance underwriter for submittals, approvals, materials, installation, inspections, and testing.
- F. Licensed Engineer: Submit design drawings, design calculations, and installation inspection reports. Include seal and signature of registered engineer licensed in jurisdiction where Project is located, certifying compliance with specifications.
- G. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced (minimum of 5 previous projects similar in size and scope to this Project) in such work, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. Submit evidence of qualifications to the Architect upon request. Refer to Division 1 Section "Reference Standards and Definitions" for definition of "Installer."
- H. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:
 - 1. NFPA 13 "Standard for the Installation of Sprinkler Systems."
 - 2. NFPA 13R "Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - 3. NFPA 14 "Standard for the Installation of Standpipe and Hose Systems."
 - 4. NFPA 26 "Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection."
 - 5. NFPA 70 "National Electrical Code."
 - 6. NFPA 231 "Standard for General Storage."
 - 7. NFPA 231C "Standard for Rack Storage of Materials."

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. Specialty Valves and Water Motor Alarms:
 - a. ASCOA Fire Systems, Figgie International Co.
 - b. Central Sprinkler Corp.
 - c. Firematic Sprinkler Devices, Inc.
 - d. Gem Sprinkler Co. Div., Grinnell Corp.
 - e. Globe Fire Sprinkler Corp.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Star Sprinkler Corp.
 - h. Viking Corp.
 - 2. Detector Check Valves:
 - a. Ames Co., Inc.
 - b. Cla-Val Co.
 - c. Hersey Products, Inc., Grinnell Corp.
 - d. Kennedy Valve Div., McWane, Inc.
 - e. Viking Corp.
 - f. Watts Regulator Co.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

3. Water Meters:
 - a. Badger Meter, Inc.
 - b. Hersey Products, Inc., Grinnell Corp.
 - c. Kent Meters, Inc.
 - d. Neptune Water Div., Schlumberger Industries, Inc.
 - e. Sensus Technologies, Inc., BTR Co.
4. Backflow Preventers:
 - a. Ames Co., Inc.
 - b. Cla-Val Co.
 - c. Conbraco Industries, Inc.
 - d. Febco.
 - e. Hersey Products, Inc., Grinnell Corp.
 - f. Watts Regulator Co.
 - g. Wilkins Regulator Div., Zurn Industries, Inc.
5. Waterflow Indicators and Supervisory Switches:
 - a. Gamewell Co.
 - b. Gem Sprinkler Co. Div., Grinnell Corp.
 - c. Potter Electric Signal Co.
 - d. Reliable Automatic Sprinkler Co., Inc.
 - e. System Sensor Div., Pittway Corp.
 - f. Victaulic Company of America.
 - g. Watts Regulator Co.
6. Fire Department Connections:
 - a. Badger-Powhatan, Figgie International Co.
 - b. Croker Div., Fire-End and Croker Corp.
 - c. Elkhart Brass Mfg. Co., Inc.
 - d. Firematic Sprinkler Devices, Inc.
 - e. Gem Sprinkler Co. Div., Grinnell Corp.
 - f. Guardian Fire Equipment, Inc.
 - g. Potter-Roemer Div., Smith Industries, Inc.
 - h. Reliable Automatic Sprinkler Co., Inc.
 - i. Sierra Fire Equipment Co.
7. Excess Pressure Pumps:
 - a. Gamewell Co.
8. Sprinklers:
 - a. ASCOA Fire Systems, Figgie International Co.
 - b. Central Sprinkler Corp.
 - c. Firematic Sprinkler Devices, Inc.
 - d. Gem Sprinkler Co. Div., Grinnell Corp.
 - e. Globe Fire Sprinkler Corp.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Star Sprinkler Corp.
 - h. Viking Corp.
9. Hose Valves and Racks and Hose:

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- a. Badger-Powhatan, Figgie International Co.
 - b. Croker Div., Fire-End and Croker Corp.
 - c. Elkhart Brass Mfg. Co., Inc.
 - d. Guardian Fire Equipment, Inc.
 - e. Potter-Roemer Div., Smith Industries, Inc.
 - f. Sierra Fire Equipment Co.
10. Indicator Posts and Indicator Post Gate Valves:
- a. Clow Valve Co. Div., McWane, Inc.
 - b. Gem Sprinkler Co. Div., Grinnell Corp.
 - c. Kennedy Valve Div., McWane, Inc.
 - d. Nibco, Inc.
 - e. Stockham Valves and Fittings, Inc.
 - f. Waterous Co.
11. Indicator Valves:
- a. Gem Sprinkler Co. Div., Grinnell Corp.
 - b. Grinnell Supply Sales Co., Grinnell Corp.
 - c. Kennedy Valve Div., McWane, Inc.
 - d. Milwaukee Valve Co., Inc.
 - e. Nibco, Inc.
 - f. Sprink-Line by Sprink, Inc.
 - g. Victaulic Company of America.
12. Fire Protection Service Gate and Check Valves:
- a. Gem Sprinkler Co. Div., Grinnell Corp.
 - b. Kennedy Valve Div., McWane, Inc.
 - c. Nibco, Inc.
 - d. Stockham Valves and Fittings, Inc.
 - e. Victaulic Company of America.
13. Grooved Couplings for Steel Piping:
- a. Grinnell Supply Sales Co., Grinnell Corp.
 - b. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.
 - c. Sprink-Line by Sprink, Inc.
 - d. Stockham Valves and Fittings, Inc.
 - e. Victaulic Company of America.
14. Grooved Couplings for AWWA Ductile-Iron Piping:
- a. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.
 - b. Victaulic Company of America.
15. Grooved Couplings for Copper Tubing:
- a. Victaulic Company of America.
16. Press-Seal Fittings for Steel Piping:
- a. Victaulic Company of America.
17. Mechanically Formed Outlet Procedure:

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- a. T-Drill Industries, Inc.

2.2 PIPES AND TUBES

- A. Refer to Part 3 Articles "Sprinkler System Piping Applications" and "Standpipe System Piping Applications" for identification of systems where pipe and fitting materials specified below are used.
- B. Steel Pipe: ASTM A 53, Schedule 40 in sizes 6 inches and smaller and Schedule 30 in sizes 8 inches and larger, black and galvanized, plain and threaded ends, for welded, threaded, cut-groove, and rolled-groove joints.

2.3 PIPE AND TUBE FITTINGS

- A. Grooved-End Fittings for Steel Pipe: UL-listed and FM-approved, ASTM A 536, Grade 65-45-12 ductile iron or ASTM A 47 Grade 32510 malleable iron, with grooves or shoulders designed to accept grooved couplings.

2.4 JOINING MATERIALS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joining materials not included in this Section.
- B. Couplings for Grooved-End Steel Pipe and Grooved-End Ferrous Fittings: UL 213, AWWA C606, ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design; ASTM A 183 carbon-steel bolts and nuts; and locking pin, toggle, or lugs to secure grooved pipe and fittings.
 - 1. Dry-Pipe-Systems Couplings: UL-listed for dry-pipe service.

2.5 GENERAL-DUTY VALVES

- A. Refer to Division 15 Section "Valves" for general-duty gate, ball, butterfly, globe, and check valves.

2.6 FIRE PROTECTION SERVICE VALVES

- A. General: UL-listed and FM-approved, with 175-psig non-shock minimum working pressure rating.
 - 1. Option: Valves for use with grooved piping may be grooved type.
- B. Gate Valves, 2 Inches and Smaller: UL 262, cast-bronze, threaded ends, solid wedge, outside screw and yoke, rising stem.
- C. Indicating Valves, 2-1/2 Inches and Smaller: Butterfly or ball type, bronze body with threaded ends, and integral indicating device.
 - 1. Indicator: Visual.
 - 2. Indicator: Electrical 115 volts a.c., prewired, single-circuit, supervisory switch.
 - 3. Indicator: Electrical 115 volts a.c., prewired, 2-circuit, supervisory switch.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- D. Gate Valves, 2-1/2 Inches and Larger: UL 262, iron body, bronze mounted, taper wedge, outside screw and yoke, rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.
- E. Gate Valves, 2-1/2 Inches and Larger for Use with Indicator Posts: UL 262, iron body, bronze mounted, solid wedge disc, non-rising stem with operating nut and flanged ends.
- F. Indicator Posts: UL 789, wall type, cast-iron body, with windows for target plates that indicate valve position, extension rod and coupling, locking device, and red enamel finish.
 - 1. Operation: Hand wheel.
- G. Swing Check Valves, 2-1/2 Inches and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze disc ring and flanged ends.
- H. Butterfly Check Valves, 4 Inches and Larger: UL 312, split-clapper style, cast-iron body with rubber seal, bronze alloy discs, stainless-steel spring and hinge pin.

2.7 SPECIALTY VALVES

- A. Alarm Check Valves: UL 193, 175-psig working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, precision retarding chamber, and fill line attachment with strainer.
 - 1. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
 - 2. Option: Grooved-end connections for use with grooved-end piping.
- B. Alarm Check Valves: UL 193, 175-psig working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Provide trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, drip cup assembly piped without valves separate from main drain line, and fill line attachment with strainer.
 - 1. Option: Grooved-end connections for use with grooved-end piping.
- C. Pressure-Regulating Valves: UL 1468, 400-psig minimum rating, brass, pressure-regulating type. Include female NPS inlet and outlet and adjustable setting feature. Size 1-1/2 inches or 2-1/2 inches, and straight or 90 degree angle (1.57 rad) pattern design as indicated.
 - 1. Optional Finish: Rough chrome plate.
- D. Ball Drip Valves: UL 1726, automatic drain valve, 3/4-inch size, spring-loaded, ball check device with threaded ends.
- E. Detector Check Valves: UL 213, galvanized cast-iron body, bolted cover with air bleed device for access to internal parts, and flanged ends; designed for 175-psig working pressure. Include 1-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in the inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
 - 1. Water Meter: AWWA C700, disc type, of size and end connections at least one-fourth those of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

2.8 BACKFLOW PREVENTERS

- A. General: ASSE standard backflow preventers, of size indicated for maximum flow rate indicated and maximum pressure loss indicated.
 - 1. Working Pressure: 150 psig minimum except where indicated otherwise.
 - 2. Bronze, cast-iron, steel, or stainless-steel body with flanged ends.
 - 3. Interior Lining: FDA-approved epoxy coating, for backflow preventers having cast-iron or steel body.
 - 4. Interior Components: Corrosion-resistant materials.
 - 5. Strainer on inlet, where strainer is indicated.
- B. Reduced-Pressure Detector Assembly Backflow Preventers: UL 312 and ASSE 1047, consisting of OS&Y gate valves on inlet and outlet, and strainer on inlet. Include pressure-differential relief valve having ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves, test cocks, and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer, for continuous pressure application.
 - 1. Pressure Loss: 12 psig maximum, through middle third of flow range.
- C. Double-Check Detector Assembly Backflow Preventers: UL 312 and ASSE 1048, consisting of OS&Y gate valves on inlet and outlet and strainer on inlet. Include 2 positive-seating check valves and test cocks, and bypass with displacement-type water meter, valves, and double-check backflow preventer, for continuous pressure application.
 - 1. Pressure Loss: 5 psig maximum, through middle third of flow range.

2.9 EXCESS PRESSURE PUMPS

- A. Description: UL-listed, factory-fabricated, positive-displacement, gear-type pump assembly. Include controls, wet-pipe kit, switches, pipe fittings, valves, mounting brackets, and connections for power, hydraulic piping, and wiring from alarm devices. Characteristics are:
 - 1. Pump and Motor: Directly connected.
 - 2. Motor Control: By differential pressure switch.
 - 3. Lights: To indicate sprinkler system operating condition:
 - a. White Light: Pressure is normal.
 - b. Red Light: Pressure is low.
 - 4. Pump Capacity: Approximately 1 GPM.
 - 5. Pump Discharge Head: Approximately 130 psig, and limited to 175 psig maximum.
 - 6. Motor: 1/4 horsepower, 115 volts a.c., 60 Hz.

2.10 SPRINKLERS

- A. Automatic Sprinklers: With heat-responsive element conforming to:
 - 1. UL 199, for applications except residential.
 - 2. UL 1626, for residential applications.
 - 3. UL 1767, for early-suppression, fast-response applications.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- B. Sprinkler types and categories are as indicated and as required by application. Furnish automatic sprinklers with nominal 1/2-inch orifice for "Ordinary" temperature classification rating except where otherwise indicated and required by application.
- C. Sprinkler types, features, and options include:
 - 1. Concealed ceiling sprinklers, including cover plate.
 - 2. Pendent sprinklers.
 - 3. Sidewall sprinklers.
 - 4. Upright sprinklers.
- D. Sprinkler Finishes: Chrome-plated, bronze, and painted.
- E. Special Coatings: Wax, lead, and corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, 1-piece, flat.
 - 2. Sidewall Mounting: Chrome-plated steel, 1-piece, flat.

2.11 SPECIALTY SPRINKLER FITTINGS

- A. Specialty Fittings: UL-listed and FM-approved, made of steel, ductile iron, or other materials compatible with system materials and applications where used.
- B. Press-Seal Fittings: UL 213, carbon-steel housing with butylene O-rings and pipe stop, for use with plain-end, Schedule 5 steel pipe.
- C. Locking-Lug Fittings: UL 213, ductile-iron body with locking-lug ends, for use with plain-end steel pipe.
- D. Mechanical-"T" Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, bolts, and threaded or locking-lug outlet.
- E. Mechanical-Cross Fittings: UL 213, ductile-iron housing with pressure-responsive gaskets, bolts, and threaded or locking-lug outlets.
- F. Drop-Nipple Fittings: UL 1474, with threaded inlet, threaded outlet, and seals; adjustable.
- G. Sprinkler Alarm Test Fittings: Ductile-iron housing with 1-1/2-inch inlet and outlet, integral test valves, combination orifice and sight glass, and threaded or locking-lug ends.

2.12 NONADJUSTABLE HOSE VALVES

- A. General: UL 668, 300-psig minimum rating, brass, nonadjustable type, hose valve for connection of fire hose. Include 90 degree angle (1.57 rad) pattern design, female NPS inlet and male hose outlet, and lugged cap, gasket, and chain. Size 2-1/2 inches as indicated. Hose valve threads are according to NFPA 1963 and match local fire department threads.

- 1. Finish: Rough chrome plated.

2.13 PRESSURE-REGULATING HOSE VALVES

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- A. General: UL 1468, 400-psig minimum rating, brass, pressure-regulating type hose valve for connection of fire hose. Include 90 degree angle (1.57 rad) pattern design, female NPS inlet and male hose outlet, and lugged cap, gasket, and chain. Size 2-1/2 inches. Hose valve threads are according to NFPA 1963 and match local fire department threads.

1. Finish: Polished brass.

2.14 HOSE RACKS AND HOSES

- A. General: UL 47, semiautomatic hose rack assembly. UL 668, 300-psig minimum rating, brass, nonadjustable-type hose valve. Include 90 degree angle (1.57 rad) pattern design valve, with NPS female inlet and outlet, brass rack nipple and hose rack, lined fire hose, couplings, gaskets, and nozzle. Include pipe clamp or wall bracket for free-standing unit; pipe escutcheon for cabinet-mounted unit; automatic drain valve; and brass, adjustable, flow-restricting device where indicated. Hose is lined type according to NFPA 1961. Hose couplings are according to UL 236, and threads and gaskets are according to NFPA 1963. Hose threads match local fire department threads. Nozzles are according to UL 401. Automatic drain valves are according UL 1726.

1. Hose Jacket Material: Combination of natural and synthetic thread.
2. Hose Lining: Thermoplastic material.

- B. 2-1/2-Inch Valve/1-1/2-Inch Hose Stations: Include 2-1/2-inch valve, 2-1/2-inch by 1-1/2-inch reducer, hose rack with water retention device and pins for folded hose, 1-1/2-inch lined hose with swivel inlet coupling, nozzle, and spanner wrench for removal of reducing coupling.

1. Hose Rack Finish: Red enamel.
2. Valve and Trim Finish: Rough brass.
3. Fire Hose: Lined, 100 foot length.
4. Nozzle: Brass, adjustable from shutoff to fog spray to straight stream.
5. Adjustable Restricting Device: Include where indicated.

2.15 FIRE DEPARTMENT CONNECTIONS

- A. Flush, Wall-Type Fire Department Connections: UL 405, cast-brass body; NH-standard thread inlets according to NFPA 1963 and matching local fire department threads; and threaded NPS outlet. Include lugged cap, gasket, and chain; lugged swivel connection, extension pipe nipples, and clappers for each hose connection inlet; and wall escutcheon plate with marking "AUTO SPKR & STANDPIPE."

1. Connections: Two 2-1/2-inch inlets and 4-inch outlet.
2. Connections: Six 2-1/2-inch inlets and 6-inch outlet.
3. Connections: Six 2-1/2-inch inlets and 8-inch outlet.
4. Inlet Alignment: In line, horizontal.
5. Inlet Alignment: In line, vertical.
6. Inlet Alignment: Square.
7. Clapper Type: Drop clappers in body.
8. Clapper Type: Female clapper snouts.
9. Clapper Type: Check snouts.
10. Direction of Outlet: Back.
11. Direction of Outlet: Top.
12. Direction of Outlet: Bottom.
13. Direction of Outlet: End.
14. Escutcheon Plate: Round.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

15. Escutcheon Plate: Square.
16. Escutcheon Plate: Rectangular.
17. Finish: Polished chrome plated.
18. Finish: Rough chrome plated.
19. Finish: Polished brass.

- B. Exposed, Wall-Type Fire Department Connections: UL 405, cast-brass body; NH-standard thread inlets according to NFPA 1963 and matching local fire department threads; and threaded NPS outlet. Include lugged cap, gasket, and chain; lugged swivel connection and drop clappers for each hose connection inlet; and round wall escutcheon plate with marking "AUTO SPKR & STANDPIPE."

1. Connections: Two 2-1/2-inch inlets and 4-inch outlet.
2. Finish: Polished brass.

2.16 ALARM DEVICES

- A. Alarm Devices: Types and sizes that will match piping and equipment connections.
- B. Water-Motor-Operated Alarms: UL 753, mechanical operation type, 10-inch diameter, cast-aluminum alarm gong, with red enamel factory finish. Include Pelton-wheel-type operator with nylon shaft bearings, and shaft length and sleeve to suit wall thickness and construction; 3/4-inch inlet and 1-inch drain.
- C. Pressure Switches: UL 753, waterflow switch with retard, electrical-supervision type, SPDT (single-pole, double-throw), normally closed contacts, designed to operate on rising pressure and signal water flow.
- D. Supervisory Switches: UL 753, for valves, electrical-supervision type, SPDT (single-pole, double-throw), normally closed contacts, designed to signal controlled valve in other than full open position.
- E. Supervisory Switches: UL 753, for indicator posts, electrical-supervision type, SPDT (single-pole, double throw), normally closed contacts, designed to signal controlled valve in other than full open position.

2.17 PRESSURE GAGES

- A. Pressure Gages: UL 393, 3-1/2 to 4-1/2 inches diameter dial with dial range of 0-250 psig.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose valves, hose racks, and cabinets to verify actual locations of piping connections prior to installing cabinets.
- B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for cabinets, and other conditions where cabinets are to be installed.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 SPRINKLER SYSTEM PIPING APPLICATIONS

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- A. Refer to Part 2 of this Section for detailed specifications on pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping may be joined with flanges instead of indicated joints. Use grooved-end fittings with grooved couplings that are made by the same manufacturer and that comply with listing when used together for grooved-coupling joints.
 - 1. Option: Mechanical-"T" bolted-branch-outlet fittings, instead of fitting types specified may be used for branch connections.
 - 2. Option: Specialty sprinkler fittings, including mechanical-"T" fittings, may be used instead of specified fittings downstream of zone valves.
- B. Pipe Between Fire Department Connections and Check Valves: Use galvanized-steel pipe instead of black-steel pipe when steel pipe is specified for applications below. Do not use welded joints.
- C. Sizes 2 Inches and Smaller: ASTM A 53, A 135, or A 795; Schedule 40 steel pipe with rolled-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints.
- D. Sizes 2-1/2 Inches to 6 Inches: ASTM A 53, A 135, or A 795; Schedule 40 steel pipe with rolled-groove ends, grooved-end steel pipe fittings, and grooved-coupling joints.
- E. Sizes 8 Inches and Larger: ASTM A 53 or A 795, Schedule 30 steel pipe with rolled-groove ends, steel pipe grooved-end fittings, grooved couplings, and grooved-coupling joints.

3.3 STANDPIPE SYSTEM PIPING APPLICATIONS

- A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping may be joined with flanges instead of indicated joints. Use grooved-end fittings with grooved couplings that are made by the same manufacturer and that comply with listing when used together for grooved-coupling joints.
- B. Pipe Between Fire Department Connections and Check Valves: Use galvanized-steel pipe instead of black-steel pipe when steel pipe is specified for applications below. Do not use welded joints.
- C. Sizes Smaller Than 4 Inches: ASTM A 53, A 135, or A 795; Schedule 40 steel pipe with rolled-groove ends, steel pipe grooved-end fittings, steel pipe grooved couplings, and grooved-coupling joints.
- D. Sizes 4 Inches to 6 Inches: ASTM A 53, A 135, or A 795; Schedule 40 steel pipe with rolled-groove ends, steel pipe grooved-end fittings, steel pipe grooved couplings, and grooved-coupling joints.
- E. Sizes 8 Inches and Larger: ASTM A 53 or A 795, Schedule 30 steel pipe with rolled-groove ends, steel pipe grooved-end fittings, steel pipe grooved couplings, and grooved-coupling joints.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use gate, ball, or butterfly valves.
 - 2. Throttling Duty: Use globe, ball, or butterfly valves.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

3.5 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Grooved-End Pipe and Grooved-End Fitting Joints: Use grooved-end fittings and grooved couplings that are made by the same manufacturer and that are listed for use together. Groove pipe and assemble joints with grooved coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
 - 1. Groove Type: Rolled.
- C. Grooved-End Copper Tube and Grooved-End Fitting Joints: Use grooved-end fittings and grooved couplings that are made by the same manufacturer and that are listed for use together. Roll-groove tube and assemble joints with grooved coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. Brazed Joints: Use AWS A5.8, BCuP-3, or BCuP-4 filler metals.
- E. Mechanically Formed Outlet Joints: Use UL-listed procedure and follow forming equipment manufacturer's written instructions. Drill pilot hole in tube, form branch for collar, dimple tube to form seating stop, and braze branch tube into formed-collar outlet.
- F. Press-Seal Fitting Joints: Follow manufacturer's written instructions, including use of specific equipment, pressure sealing tool, and accessories made for this procedure.
- G. Locking-Lug Joints: Follow manufacturer's written instructions.
- H. Dissimilar Materials Piping Joints: Make joints using adapters compatible with both piping materials.
- I. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.
- J. PB Heat-Fusion Joints: Conform to ASTM D 3309.

3.6 SERVICE ENTRANCE PIPING

- A. Connect fire protection piping to water service piping of size and in location indicated for service entrance to building. Water service piping is specified in Division 2 Section "Water Systems."
- B. Install shutoff valve, check valve, pressure gage, drain, and other accessories indicated at connection to water service piping.
- C. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to fire service piping.

3.7 WATER SUPPLY CONNECTION

- A. Connect fire protection piping to water supply piping of size and in location indicated.
- B. Install shutoff valve, check valve, pressure gage, drain, and other accessories indicated at connection to water supply piping.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- C. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water supply piping.

3.8 PIPING INSTALLATIONS

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved "working plans" for sprinkler piping require written approval from authority with jurisdiction. File written approval with the Architect prior to deviating from approved "working plans."
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes 2 inches and smaller. Unions are not required on flanged devices or in piping installations using grooved couplings.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2-inch and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler zone control valves, test assemblies, and drain headers adjacent to standpipes when sprinkler piping is connected to standpipe.
- I. Install drain valves on standpipe systems, of sizes and in locations indicated.
- J. Install ball drip valves to drain piping between fire department connections and check valves, and where indicated. Drain to floor drain or outside building.
- K. Install alarm devices in piping systems.
- L. Hangers and Supports: Comply with NFPA 13. Install according to NFPA 13 and NFPA 14.
 - 1. Install hanger and support spacing and locations for steel piping joined with grooved mechanical couplings according to manufacturer's written instructions for rigid systems.
 - 2. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than 1/4 inch and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

3.9 SPECIALTY SPRINKLER FITTING INSTALLATIONS

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

- A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.10 VALVE INSTALLATIONS

- A. Refer to Division 15 Section "Valves" for installation of general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and the authority having jurisdiction.
- B. Gate Valves: Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than 1 control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water supply connection. Install backflow preventers instead of check valves in potable water supply sources.
- D. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain line connection.
- E. Detector Check Valves: Install for proper direction of flow, located to detect system leakage and unauthorized use of water and to prevent backflow into public water mains. Install bypass with water meter, with gate valves on each side of meter, and check valve downstream from meter.

3.11 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Comply with plumbing code and authority with jurisdiction. Install air-gap fitting on units with atmospheric vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.

3.12 SPRINKLER APPLICATIONS

- A. Rooms without Ceilings: Upright sprinklers.
- B. Rooms with Suspended Ceilings: Concealed sprinklers.
- C. Wall Mounting: Sidewall sprinklers.
- D. Sprinkler Finishes: Use sprinklers with following finishes:
 - 1. Upright, Pendent, and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax-coated where exposed to acids, chemicals, or other corrosive fumes.
 - 2. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 3. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - 4. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

3.13 SPRINKLER INSTALLATIONS

- A. Install sprinklers in patterns indicated.
- B. Install sprinklers in suspended ceilings in center of acoustical panels and tiles.
- C. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical panels.
- D. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers supplied from heated space.

3.14 HOSE VALVE INSTALLATIONS

- A. Hose Outlet Valves: Install 2-1/2-inch hose outlet valves with quick-disconnect 2-1/2-inch to 1-1/2-inch reducing coupling and flow restriction device at each standpipe outlet for hose connections.

3.15 HOSE VALVE AND RACK AND HOSE INSTALLATIONS

- A. Install free-standing hose valves and racks and hose assemblies for access and minimum passage restriction.
- B. Free-Standing Hose Valves: Install 2-1/2-inch hose valves where indicated.
- C. Free-Standing Racks and Hoses: Install racks and hose assemblies in locations indicated.
- D. Cabinet-Mounted Hose Valves: Install 2-1/2-inch hose valves in cabinets specified in Division 10 Section "Fire Extinguishers, Cabinets, and Accessories" where indicated. Include pipe escutcheon with finish matching valve on supply pipe inside cabinet.
- E. Cabinet-Mounted Racks and Hoses: Install in cabinets specified in Division 10 Section "Fire Extinguishers, Cabinets, and Accessories" in locations indicated. Include pipe escutcheon with finish matching valve, on supply pipe inside cabinet. Install flow-restricting device where indicated.
- F. Include 2-1/2-inch by 1-1/2-inch reducer on 2-1/2-inch valves where indicated.
- G. Install hose valves in cabinets at angle required for connection of fire hose.

3.16 EXCESS PRESSURE PUMP INSTALLATION

- A. Install excess pressure pumps, controls, devices, and supports according to manufacturer's written installation instructions for wet-pipe sprinkler system application.
 - 1. Mounting: Install mounted on wall, where indicated.

3.17 FIRE DEPARTMENT CONNECTION INSTALLATIONS

- A. Install fire department connections of types and features indicated in locations indicated.
- B. Install ball drip valves at each check valve for fire department connection to mains and where indicated. Drain to floor drain or outside building.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

3.18 CONNECTIONS

- A. Connect to specialty valves, hose valves, specialties, fire department connections, and accessories.
- B. Connect water supplies to standpipe and sprinkler systems. Include backflow preventers.
- C. Connect water supply piping to fire pump system piping. Fire pumps, pressure maintenance pumps, controllers, and accessories are specified in Division 15 Section "Fire Pumps."
- D. Electrical Connections: Power wiring is specified in Division 16.
- E. Connect alarm devices to fire alarm system.
- F. Connect excess pressure pumps to following piping and wiring:
 - 1. Hydraulically to sprinkler system.
 - 2. Hydraulically to pressure gages and controls.
 - 3. To electrical power system.
 - 4. To alarm device accessories for pump.
 - 5. To fire alarm system.

3.19 FIELD QUALITY CONTROL

- A. Perform field acceptance tests of each fire protection system.
 - 1. Flush, test, and inspect sprinkler piping systems according to NFPA 13 Chapter "System Acceptance."
 - 2. Flush, test, and inspect standpipe systems according to NFPA 14 Chapter "Tests and Inspection."
- B. Replace piping system components that do not pass test procedures specified, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
 - 1. Report test results promptly and in writing to Architect.
 - 2. Report test results promptly and in writing to authority having jurisdiction when required.

3.20 CLEANING

- A. Clean dirt and debris from sprinklers. Replace sprinklers having paint other than factory finish with new sprinklers. Cleaning and reuse of painted sprinklers is prohibited.

3.21 COMMISSIONING

- A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:
 - 1. Verify that specialty valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly.
 - 2. Verify that excess pressure pumps and accessories have been installed correctly and operate correctly.
 - 3. Verify that specified tests of piping are complete.

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

4. Check that damaged sprinklers and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.
 5. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.
 6. Check that potable water supplies have correct type of backflow preventer.
 7. Check that hose valves and fire department connections have threads compatible with local fire department equipment and have correct pressure rating.
 8. Fill wet-pipe sprinkler systems with water.
 9. Fill wet standpipe systems with water.
 10. Check for correct type and size hose valves.
 11. Check for correct type and size hose valves, racks, hoses, and nozzles.
 12. Energize circuits to electrical equipment and devices.
 13. Start and run excess pressure pumps.
 14. Adjust operating controls and pressure settings.
- B. Coordinate with fire alarm system tests. Operate systems as required.
- C. Coordinate with fire pump tests. Operate systems as required.

3.22 DEMONSTRATION

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. Schedule demonstration with at least 7 days' advance notice.

END OF SECTION 211313

SECTION 221116 – DOMESTIC WATER PIPING

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 water distribution piping from locations indicated to fixtures and equipment inside building.

1.3 DEFINITIONS

- A. Water Service Piping: Water piping outside building that conveys water to building.
- B. Service Entrance Piping: Water piping at entry into building between water service piping and water distribution piping.
- C. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.
- D. The following are industry abbreviations for plastic piping materials:
 - 1. CPVC: Chlorinated polyvinyl chloride.
 - 2. NP: Nylon.
 - 3. PB: Polybutylene.
 - 4. PE: Polyethylene.
 - 5. PP: Polypropylene.
 - 6. PVC: Polyvinyl chloride.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Combined Fire-Protection and Domestic, Service Entrance Piping: 250 psig.
 - 2. Service Entrance Piping: 160 psig.
 - 3. Water Distribution Piping: 125 psig.
 - 4. Service Entrance Piping: 100 psig.
 - 5. Water Distribution Piping: 80 psig.

1.5 SUBMITTALS

- A. Water Samples, Test Results, and Reports: Specified in "Field Quality Control" and "Cleaning" articles.

1.6 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

SECTION 221116 – DOMESTIC WATER PIPING

- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic potable-water piping components. Include marking "NSF-pw" on plastic potable-water piping.
- D. Comply with NSF 61, "Drinking Water System Components--Health Effects," Sections 1 through 9 for potable-water piping and components.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
- C. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
- D. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80.
- E. PVC Plastic Pipe: AWWA C900, Classes 150 and 200; with bell end with gasket, and spigot end.

2.2 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. Copper, Solder-Joint Pressure Fittings: ASME B16.18 cast-copper alloy or ASME B16.22 wrought copper.
- C. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- E. Copper Unions: ASME B16.18, cast-copper-alloy, hexagonal-stock body with ball-and-socket joint, metal-to-metal seating surfaces, and solder-joint, threaded, or solder-joint and threaded ends. Include threads conforming to ASME B1.20.1 on threaded ends.
- AF. Schedule 80, PVC Socket Fittings: ASTM D 2467.
- AG. Schedule 40, PVC Socket Fittings: ASTM D 2466.
- AI. PVC Gasketed Fittings: AWWA C907, Class 150; with gaskets.

2.3 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

SECTION 221116 – DOMESTIC WATER PIPING

- B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.
- C. Solder: ASTM B 32, Alloy Sn95, Sn94, or E; lead free.
- D. Brazing Filler Metal: AWS A5.8, BCuP, copper phosphorus or BAg, silver classification.
- E. Copper, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- F. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

2.4 VALVES

- A. CPVC Plastic Valves: CPVC plastic body material similar to CPVC plastic piping system with seats, seals, and other components suitable for potable-water service. Comply with the following:
 - 1. Ball Valves, 3-Inch NPS and Smaller: Union type with socket or threaded ends.
 - 2. Check Valves, 4-Inch NPS and Smaller: Ball type with socket ends.
- B. PVC Plastic Valves: PVC plastic body material with seats, seals, and other components suitable for potable-water service. Comply with the following:
 - 1. Ball Valves: Union type with socket or threaded ends.
 - 2. Check Valves, 2-Inch NPS and Smaller: Diaphragm or ball type with threaded or socket ends.
 - 3. Check Valves, 3-Inch NPS and Larger: Swing or ball type with flanged ends.
- C. PVC Plastic Valves: PVC plastic body material similar to PVC plastic piping system with seats, seals, and other components suitable for non-potable-water service. Comply with the following:
 - 1. Ball Valves: Union type with socket or threaded ends.
 - 2. Check Valves, 2-Inch NPS and Smaller: Diaphragm or ball type with threaded ends.
 - 3. Check Valves, 3-Inch NPS and Larger: Swing or ball type with flanged ends.
 - 4. Gate Valves: Nonrising-stem type with flanged ends.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.

SECTION 221116 – DOMESTIC WATER PIPING

- C. Fitting Option: Mechanically formed tee-branch outlets and brazed joints may be used on aboveground copper tubing.
- D. Underground, Service Entrance Piping: Do not use flanges or valves underground. Use the following:
 - 1. 2-Inch NPS and Smaller: Soft copper tube, Type K; copper, solder-joint pressure fittings; and soldered joints.
 - 2. 2-1/2- to 3-1/2-Inch NPS: Soft copper tube, Type K; copper, solder-joint pressure fittings; and soldered joints.
 - 3. 4- to 8-Inch NPS: Ductile-iron pipe and fittings, and mechanical or push-on joints.
 - 4. 10- and 12-Inch NPS: Ductile-iron pipe and fittings, and mechanical or push-on joints.
- E. Aboveground, Water Distribution Piping: Use the following:
 - 1. 1-1/2-Inch NPS and Smaller: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.
 - 2. 2-Inch NPS: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.
 - 3. 2-1/2- to 3-1/2-Inch NPS: Hard copper tube, Type L; copper, solder-joint fittings; and soldered joints.
 - 4. 4- to 6-Inch NPS: Hard copper tube, Type L with grooved ends; copper, grooved-end fittings; and copper, keyed couplings.
 - 5. 4- to 6-Inch NPS: Flanged, ductile-iron pipe and flanged, ductile-iron fittings.
 - 6. 4- to 6-Inch NPS: Ductile-iron pipe and fittings with grooved ends and ductile-iron, keyed couplings.
 - 7. 8-Inch NPS: Flanged, ductile-iron pipe and flanged, ductile-iron fittings.
 - 8. 10- and 12-Inch NPS: Flanged, ductile-iron pipe and flanged, ductile-iron fittings.
- F. Underground, Water Distribution Piping: Do not use flanges or valves underground. Use the following:
 - 1. 2-Inch NPS and Smaller: Hard copper tube, Type L; wrought-copper, solder-joint pressure fittings; and soldered joints.
 - 2. 2-1/2- to 4-Inch NPS: Hard copper tube, Type L; wrought-copper, solder-joint pressure fittings; and soldered joints.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use gate, ball, or butterfly valves.
 - 2. Throttling Duty: Use globe, ball, or butterfly valves.
- B. Grooved-end butterfly valves may be used with grooved-end piping.
- C. Plastic gate, globe, ball, butterfly, and check valves may be used with plastic piping.

3.4 PIPING INSTALLATION, GENERAL

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

3.5 SERVICE ENTRANCE PIPING INSTALLATION

SECTION 221116 – DOMESTIC WATER PIPING

- A. Extend service entrance piping to exterior water service piping in sizes and locations indicated for service entrances into building. Refer to Division 2 Section "Water Systems" for water service piping.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each service entrance pipe.
- C. Ductile-Iron, Service Entrance Piping: Comply with AWWA C600. Install buried piping between shutoff valve and connection to water service piping with restrained joints. Anchor pipe to wall or floor at entrance. Include thrust-block supports at vertical and horizontal offsets.
 - 1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.
- E. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

3.6 WATER DISTRIBUTION PIPING INSTALLATION

- A. Install piping with 0.25 percent slope downward toward drain.
- B. Install piping level without pitch.
- C. Fitting Option for Hard Copper Tube: Mechanically formed tee-branch outlets may be used instead of tee fittings.

3.7 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Mechanically Formed Outlets: Form tee in copper tube according to equipment manufacturer's written instructions. Use tool designed for copper tube, drill pilot hole, form collar for outlet, dimple tube forming seating stop, and braze branch tube into collar.
- C. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. Solvent-Cemented, Thermoplastic Pipe and Fitting Joints: Handle cleaners, primers, and solvent cements according to ASTM F 402.

3.8 VALVE INSTALLATION

- A. Sectional Valves: Install sectional valves close to main on each branch and riser serving plumbing fixtures or equipment, and where indicated. Use gate or ball valves for piping 2-inch NPS and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS and larger.

SECTION 221116 – DOMESTIC WATER PIPING

- B. Shutoff Valves: Install shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated. Use gate or ball valves for piping 2-inch NPS and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS and larger.
- C. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- D. Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Use ball valve for piping 2-inch NPS and smaller and butterfly valve for piping 2-1/2-inch NPS and larger. Refer to Division 15 Section "Plumbing Specialties" for balancing valves.
- E. Calibrated Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Refer to Division 15 Section "Plumbing Specialties" for calibrated balancing valves.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Install supports according to Division 15 Section "Hangers and Supports."
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- D. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:
 - 1. 3/4-Inch NPS and Smaller: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 2. 1-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 3. 1-1/4-Inch NPS: Maximum horizontal spacing, 72 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 4. 1-1/2 and 2-Inch NPS: Maximum horizontal spacing, 96 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 5. 2-1/2-Inch NPS: Maximum horizontal spacing, 108 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 6. 3-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 7. 3-1/2-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 8. 4- and 5-Inch NPS: Maximum horizontal spacing, 10 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 9. 6-Inch NPS: Maximum horizontal spacing, 10 feet with 5/8-inch minimum rod diameter; maximum vertical spacing, 10 feet.
 - 10. 8-Inch NPS: Maximum horizontal spacing, 10 feet with 3/4-inch minimum rod diameter; maximum vertical spacing, 10 feet.
- E. Install hangers for PVC plastic piping with the following maximum spacing and minimum rod diameters:

SECTION 221116 – DOMESTIC WATER PIPING

1. 2-Inch NPS and Smaller: Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
2. 2-1/2- to 3-1/2-Inch NPS: Maximum horizontal spacing, 48 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 48 inches.
3. 4- and 5-Inch NPS: Maximum horizontal spacing, 48 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
4. 6-Inch NPS: Maximum horizontal spacing, 48 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 48 inches.
5. 8-Inch NPS: Maximum horizontal spacing, 48 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.

- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

- A. Connect service entrance piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.
- B. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:
1. Booster Systems: Connect cold-water suction and discharge piping.
 2. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 3. Plumbing Fixtures: Connect hot- and cold-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
 4. Equipment: Connect hot- and cold-water supply piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections 2-1/2-inch NPS and larger.

3.11 FIELD QUALITY CONTROL

- A. Inspect water distribution piping as follows:
- B. Inspect service entrance piping and water distribution piping as follows:
1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

SECTION 221116 – DOMESTIC WATER PIPING

- C. Test water distribution piping as follows:
- D. Test service entrance piping and water distribution piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.12 CLEANING

- A. Clean and disinfect potable-water distribution piping as follows:
- B. Clean and disinfect potable service entrance piping and water distribution piping as follows:
- C. Clean and disinfect water distribution piping as follows:
- D. Clean and disinfect service entrance piping and water distribution piping as follows:
 - 1. Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652 or as described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.
 - c. Flush system with clean, potable water until chlorine is no longer in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.
- E. Prepare and submit reports for purging and disinfecting activities.
- F. Clean interior of piping system. Remove dirt and debris as work progresses.

SECTION 221116 – DOMESTIC WATER PIPING

3.13 COMMISSIONING

- A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- B. Perform the following steps before putting into operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Check plumbing specialties and verify proper settings, adjustments, and operation.
 - 1. Water-Pressure Regulators: Set outlet pressure at 80 psig maximum, unless otherwise indicated.
- E. Energize pumps and verify proper operation.

END OF SECTION 221116

SECTION 221316 – SANITARY WASTE AND VENT PIPING

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 sanitary drainage and vent piping, and storm drainage piping inside building and to locations indicated.

1.3 DEFINITIONS

- A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building.
- B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building.
- C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping.
- D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.
- E. Force-Main Piping: Drainage piping, under pressure.
- F. The following are industry abbreviations for plastic and other piping materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene.
 - 2. EPDM: Ethylene-propylene-diene polymer, rubber.
 - 3. NBR: Acrylonitrile-butadiene rubber.
 - 4. PVC: Polyvinyl chloride.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Systems: 10-foot head of water.
 - 2. Storm Drainage Systems: 10-foot head of water.
 - 3. Sewage, Force-Main Piping Systems: 100 psig.

1.5 SUBMITTALS

- A. Test Results and Reports: Specified in "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.

SECTION 221316 – SANITARY WASTE AND VENT PIPING

- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. Ductile-Iron Pipe: AWWA C151 with mechanical- or push-on-joint bell and plain spigot end, unless plain, grooved, or flanged ends are indicated.
- C. PVC Plastic Pipe: ASTM D 2665, Schedule 40.

2.2 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns.

2.3 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
- B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Aboveground, Soil, Waste, and Vent Piping: Use the following:

SECTION 221316 – SANITARY WASTE AND VENT PIPING

1. 1-1/4- and 1-1/2-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 2- to 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
6. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

D. Underground, Soil, Waste, and Vent Piping: Use the following:

1. 1-1/2-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 2- to 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
6. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

E. Aboveground, Storm Drainage Piping: Use the following:

1. 2- to 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

F. Underground, Storm Drainage Piping: Use the following:

1. 3- and 4-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
2. 5- and 6-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
3. 8-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
4. 10-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.
5. 12-Inch NPS: PVC plastic pipe, PVC socket fittings, and solvent-cemented joints.

G. Aboveground, Sewage Force Mains: Use the following:

1. 2- to 4-Inch NPS: Galvanized steel pipe and cast-iron, threaded fittings.
2. 5- and 6-Inch NPS: Galvanized steel pipe and cast-iron, threaded fittings.

H. Underground, Sewage-Force-Main, Service Entrance Piping: Use the following:

1. 4- and 6-Inch NPS: Ductile-iron pipe; ductile-iron, mechanical- or push-on-joint fittings; rubber gaskets; and mechanical or push-on joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use gate, ball, or butterfly valves.
2. Throttling Duty: Use globe, ball, or butterfly valves.

B. Grooved-end butterfly valves may be used with grooved-end piping.

SECTION 221316 – SANITARY WASTE AND VENT PIPING

3.4 PIPING INSTALLATION, GENERAL

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

3.5 SERVICE ENTRANCE PIPING INSTALLATION

- A. Refer to Division 2 Section "Sewerage and Drainage" for sanitary and storm sewer piping.
- B. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.
- C. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building storm drains and building storm sewers.
- D. Extend building sanitary drain, force-main piping and connect to sanitary sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.
- E. Extend building storm drain, force-main piping and connect to storm sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.
- F. Ductile-Iron, Force-Main, Service Entrance Piping: Comply with AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 1. Encase piping with polyethylene film according to ASTM A 674 or AWWA C105.
- G. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.
- H. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

3.6 DRAINAGE AND VENT PIPING INSTALLATION

- A. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- B. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.

SECTION 221316 – SANITARY WASTE AND VENT PIPING

- C. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- D. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 3-inch NPS and smaller; 1 percent downward in direction of flow for piping 4-inch NPS and larger.
 - 2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Storm Building Drain: 1 percent downward in direction of flow.
 - 4. Horizontal, Storm Drainage Piping: 2 percent downward in direction of flow.
 - 5. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- E. Install force mains at elevations indicated.
- F. Install engineered, sanitary drainage and vent systems in locations indicated and as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Copper, Sovent, Single Stack: Comply with CDA 402/0, "Brass and Bronze Design Handbook, Single-Stack Plumbing System."
 - 3. Cast-Iron, Sovent, Single Stack: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
 - 4. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- G. Install engineered, controlled-flow, storm drainage systems in locations indicated. Comply with standards of authorities having jurisdiction.
- H. Sleeves are not required for cast-iron soil piping passing through concrete slab on grade if slab is without membrane waterproofing.
- I. Install ABS plastic drainage piping according to ASTM D 2661.
- J. Install PVC plastic drainage piping according to ASTM D 2665.
- K. Install underground, ABS and PVC plastic drainage piping according to ASTM D 2321.

3.7 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Compression Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- D. PVC Piping Joints: Join drainage piping according to ASTM D 2665.

SECTION 221316 – SANITARY WASTE AND VENT PIPING

- E. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings.

3.8 VALVE INSTALLATION

- A. Shutoff Valves: Install shutoff valve on each pump discharge and where indicated. Use gate or ball valves for piping 2-inch NPS and smaller. Use gate or butterfly valves for piping 2-1/2-inch NPS and larger.
- B. Check Valves: Install swing check valve on each pump discharge, downstream from shutoff valve.

3.9 HANGER AND SUPPORT INSTALLATION

- A. Install supports according to Division 15 Section "Hangers and Supports."
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- D. Install hangers for cast-iron soil piping with the following maximum spacing and minimum rod diameters:
 - 1. 1-1/2- and 2-Inch NPS: Maximum horizontal spacing, 60 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 2. 3-Inch NPS: Maximum horizontal spacing, 60 inches with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 3. 4- and 5-Inch NPS: Maximum horizontal spacing, 60 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 4. 6-Inch NPS: Maximum horizontal spacing, 60 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 5. 8- through 12-Inch NPS: Maximum horizontal spacing, 60 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 6. 15-Inch NPS: Maximum horizontal spacing, 60 inches with 1-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 7. Spacing for horizontal pipe in 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- E. Install hangers for steel and ductile-iron piping with the following maximum spacing and minimum rod diameters:
 - 1. 1-1/4-Inch NPS: Maximum horizontal spacing, 84 inches; 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 2. 1-1/2-Inch NPS: Maximum horizontal spacing, 108 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 3. 2-Inch NPS: Maximum horizontal spacing, 10 feet with 3/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 4. 2-1/2-Inch NPS: Maximum horizontal spacing, 11 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 5. 3-Inch NPS: Maximum horizontal spacing, 12 feet with 1/2-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 - 6. 4- and 5-Inch NPS: Maximum horizontal spacing, 12 feet with 5/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.

SECTION 221316 – SANITARY WASTE AND VENT PIPING

7. 6-Inch NPS: Maximum horizontal spacing, 12 feet with 3/4-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 8. 8- through 12-Inch NPS: Maximum horizontal spacing, 12 feet with 7/8-inch minimum rod diameter; maximum vertical spacing, 15 feet.
 9. 14- through 18-Inch NPS: Maximum horizontal spacing, 12 feet with 1-inch minimum rod diameter; maximum vertical spacing, 15 feet.
- F. Install hangers for ABS and PVC plastic piping with the following maximum spacing and minimum rod diameters:
1. 1-1/2- and 2-Inch NPS: Maximum horizontal spacing, 48 inches with 3/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 2. 4- and 5-Inch NPS: Maximum horizontal spacing, 48 inches with 5/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 3. 6-Inch NPS: Maximum horizontal spacing, 48 inches with 3/4-inch minimum rod diameter; maximum vertical spacing, 48 inches.
 4. 8- through 12-Inch NPS: Maximum horizontal spacing, 48 inches with 7/8-inch minimum rod diameter; maximum vertical spacing, 48 inches.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.10 CONNECTIONS

- A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.

3.11 FIELD QUALITY CONTROL

- A. Inspect drainage and vent piping as follows:
1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

SECTION 221316 – SANITARY WASTE AND VENT PIPING

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 feet of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.12 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

END OF SECTION 221316

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

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 electric water heaters and accessories.

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 including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate dimensions, finishes and coatings, required clearances, methods of assembly of components, and piping and wiring connections.
- C. Shop Drawings showing layout of each unit, including tanks, pumps, controls, related accessories, and piping.
- D. Setting Drawings with templates and directions for installing foundation bolts, anchor bolts, and other anchorages.
- E. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between factory-installed and field-installed wiring.
- F. Product certificates signed by manufacturers of water heaters certifying that their products comply with specified requirements.
- G. Certificates of shop inspection and data report as required by provisions of ASME Boiler and Pressure Vessel Code, when ASME construction is indicated.
- H. Field quality-control installation reports.
- I. Maintenance data for water heaters to include in operation and maintenance manuals specified in Division 1. Include startup instructions.

1.4 QUALITY ASSURANCE

- A. ASHRAE Standard: Comply with performance efficiencies prescribed in ASHRAE 90.1, "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings."
- B. ASHRAE Standard: Comply with performance efficiencies prescribed in ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings."
- C. NFPA Standard: Comply with NFPA 70, "National Electrical Code," for electrical components.

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

- D. Listing and Labeling: Provide electrically operated water heaters, controls, and components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in 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. Product Options: Drawings indicate size, profiles, connections, dimensional requirements, and characteristics of water heaters and accessories and are based on specific types and models indicated. Other manufacturers' water heaters and accessories with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."

1.5 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.
- B. Special Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace water heaters and accessories that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, tanks and elements. This warranty is in addition to, and not a limitation of, other rights Owner may have against Contractor under Contract Documents.
- C. Warranty Period: 5 years after 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 in the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Household, Storage, Electric Water Heaters:
 - a. American Water Heater Group.
 - b. Bradford White Corp.
 - c. Electric Heater Co.
 - d. GSW Water Heating Co.
 - e. Lochinvar Corp.
 - f. Patterson-Kelley Co.
 - g. Rheem Mfg. Co.; Rheem Water Heater Div.
 - h. Rheem Mfg. Co.; Ruud Water Heater Div.
 - i. Smith: A.O. Smith Water Products Co.
 - j. State Industries, Inc.
 - 2. Commercial, Storage, Electric Water Heaters:
 - a. American Water Heater Group.

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

- b. Aqua-Chem, Inc.; Cleaver-Brooks Div.
- c. Bock Water Heaters, Inc.
- d. Bradford White Corp.
- e. Cemline Corp.
- f. HESco Industries, Inc.
- g. Lochinvar Corp.
- h. Patterson-Kelley Co.
- i. Precision Parts Corp.
- j. PVI Industries, Inc.
- k. Rheem Mfg. Co.; Rheem Water Heater Div.
- l. Rheem Mfg. Co.; Ruud Water Heater Div.
- m. Smith: A.O. Smith Water Products Co.
- n. State Industries, Inc.

2.2 WATER HEATERS, GENERAL

- A. Specified manufacturer's standard components and features are acceptable where specific product requirements are not indicated.
- B. Temperature Control: Adjustable thermostat, except for units where other arrangement is indicated or temperature is regulated by flow-control fitting.
- C. Safety Control: Automatic, high-temperature-limit cutoff device or system on commercial units and where indicated. Include automatic low-water cutoff device or system on commercial units where indicated.
- D. Interior Finish: Materials that comply with requirements of applicable NSF, AWWA, or FDA and EPA regulatory standards for tasteless and odorless, potable-water-tank linings.
- E. Tappings: Factory fabricated of materials compatible with tank. Include tappings for piping connections, relief valves, pressure gage, thermometer, blow down, and controls as required and others as indicated. Attach tappings to tank before testing and labeling. Include tappings and connections as follows:
 - 1. 2-Inch NPS and Smaller: Threaded ends.
 - 2. 2-1/2-Inch NPS and Larger: Flanged ends.
- F. Insulation: Fiberglass, polyurethane foam, or manufacturer's standard that is suitable for operating temperature and required insulating value. Include insulation material that surrounds entire tank except connections and controls.
- G. Jacket: Steel, with baked-on enamel finish, except where otherwise specified.
- H. Anode Rods: Factory installed, magnesium.
- I. Combination Temperature and Pressure Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
 - 1. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
 - 2. Exception: Omit relief valve for tankless water heater. Include pressure relief valve for installation in piping.

2.3 HOUSEHOLD, STORAGE, ELECTRIC WATER HEATERS

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

- A. Description: UL 174, household, storage, electric water heater; with capacity more than 40 gal., but not more than 120 gal., and input not more than 12 kW.
- B. Storage Tank Construction: Steel with 150-psig working-pressure rating.
- C. Heating Elements: 2 electric, screw-in, immersion type.
- D. Temperature Control: Adjustable thermostat for each element. Include wiring arrangement for nonsimultaneous operation.
- E. Heat Traps: Manufactured, factory- or field-installed, cold-type inlet fitting in inlet and hot-type outlet fitting in outlet of household water heater.
- F. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.
- G. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
 - 1. Exception: Omit where water heater has integral vacuum relieving device.
- H. Description: UL 174, tabletop-type, household, storage, electric water heater; with capacity more than 40 gal., but not more than 120 gal., and input not more than 12 kW.
- I. Storage Tank Construction: Steel with 150-psig working-pressure rating.
- J. Heating Elements: 2 electric, screw-in, immersion type.
- K. Temperature Control: Adjustable thermostat for each element. Include wiring arrangement for nonsimultaneous operation.
- L. Jacket: Enameled steel or porcelain-enameled steel front and sides with porcelain-enameled steel top surface.
 - 1. Color: White, except where otherwise indicated.
 - 2. Top: Flat, rectangular work surface with raised back.
 - 3. Height: 36 inches, except where otherwise indicated.
- M. Drain Valve: ASSE 1005, factory or field installed. Omit when water heater is without drain outlet and include general-duty drain valve in piping.
- N. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
 - 1. Exception: Omit where water heater has integral vacuum relieving device.

2.4 COMMERCIAL, STORAGE, ELECTRIC WATER HEATERS

- A. Description: UL 1453, commercial, storage, electric water heater; with capacity more than 40 gal.
- B. Storage Tank Construction: ASME labeled, steel with 150-psig working-pressure rating.
- C. Storage Tank Construction: Steel with 150-psig working-pressure rating.
- D. Heating Elements: Electric, screw-in or bolt-on, immersion type according to the following:

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

1. Up to 9-kW Input: 2 or 3 elements.
 2. More than 9-kW Input: Elements arranged in multiples of 3.
- E. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of 3.
- F. Staging: Not exceeding 18 kW per step.
- G. Temperature Control: Adjustable immersion thermostats.
- H. Temperature Control: Adjustable surface-mounting thermostats.
- I. Safety Control: Automatic, high-temperature-limit and low-water cutoffs.
- J. Special Requirements: NSF 5 construction.
- K. Inlet and Outlet Manifolds: Fabricated by water heater manufacturer and capable of providing balanced flow through water heaters, for multiple-unit installation.
- L. Vacuum Relief Valve: Comply with ASME PTC 25.3. Furnish for installation in piping.
1. Exception: Omit where water heater has integral vacuum relieving device.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for water heaters and accessories. Refer to Division 3 Section "Cast-in-Place Concrete" and Division 15 Section "Basic Mechanical Materials and Methods."

3.2 WATER HEATER INSTALLATION

- A. General: Install water heaters on concrete bases. Set and connect units according to manufacturer's written instructions. Install units plumb, level, and firmly anchored in locations indicated. Maintain manufacturer's recommended clearances. Install so controls and devices are accessible for service.
- B. Anchor water heaters and storage tanks to substrate.
- C. Install seismic restraints as indicated.
- D. Install electric booster heaters with thermometer, pressure gage, and pressure regulator on hot-water inlet; and thermometer, pressure gage, and shock absorber on boosted-temperature, hot-water outlet.
- E. Install temperature and pressure relief valves in top portion of storage water heater tanks and hot-water storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

- F. Install pressure relief valves in hot-water-outlet piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.
- G. Install vacuum relief valves in cold-water-inlet piping.
- H. Install vacuum relief valves in water heaters and hot-water storage tanks that have copper lining.
- I. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for drain valves.
- J. Install thermometers on water heater inlet and outlet piping. Thermometers are specified in Division 15 Section "Meters and Gages."
- K. Install pressure gages on water heater piping when and as indicated. Pressure gages are specified in Division 15 Section "Meters and Gages."
- L. Install inlet and outlet piping manifolds for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through water heaters. Include throttling valves in outlet manifolds and thermometers in inlet and outlet manifolds.
- M. Install piping adjacent to water heaters to allow service and maintenance.
- N. Arrange for field-applied insulation on equipment and piping not furnished with factory-applied insulation.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 - 1. Connect hot- and cold-water piping to units with shutoff valves and unions. Connect hot-water circulating piping to unit with shutoff valve, check valve, and union.
 - 2. Make connections with dielectric fittings where piping is made of dissimilar metals. Dielectric fittings are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Electrical Connections: Power wiring and disconnect switches are specified in Division 16 Sections. Arrange wiring to allow unit servicing.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 COMMISSIONING

- A. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
 - 1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

SECTION 223300 - ELECTRIC DOMESTIC WATER HEATERS

2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
3. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
4. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
5. Schedule training with Owner with at least 7 days' advance notice.

B. Perform the following final checks before startup:

1. Fill water heaters with water.
2. Check that piping system tests are complete.
3. Check for piping connection leaks.
4. Check for clear relief valve inlets, outlets, and drain piping.
5. Check operation of pumps and circulators.
6. Test operation of safety controls, relief valves, and devices.

C. Perform the following startup procedures:

1. Energize electric circuits.
2. Adjust operating controls.
3. Adjust hot-water-outlet temperature settings.

END OF SECTION 223300

SECTION 230500 – COMMON WORK RESULT FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Concrete equipment base construction requirements.
 - 3. Equipment nameplate data requirements.
 - 4. Labeling and identifying mechanical systems and equipment is specified in Division 15 Section "Mechanical Identification."
 - 5. Nonshrink grout for equipment installations.
 - 6. Field-fabricated metal and wood equipment supports.
 - 7. Installation requirements common to equipment specification Sections.
 - 8. Mechanical demolition.
 - 9. Cutting and patching.
 - 10. Touchup painting and finishing.
- B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

- A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.
- B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for following piping specialties:

SECTION 230500 – COMMON WORK RESULT FOR HVAC

1. Mechanical sleeve seals.
 2. Identification materials and devices.
- C. Samples of color, lettering style, and other graphic representation required for each identification material and device.
- D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
- E. Coordination drawings for access panel and door locations.
- F. Prepare coordination drawings according to Division 1 Section "Submittals" to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:
1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:
 - a. Planned piping layout, including valve and specialty locations and valve stem movement.
 - b. Planned duct systems layout, including elbow radii and duct accessories.
 - c. Clearances for installing and maintaining insulation.
 - d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - e. Equipment service connections and support details.
 - f. Exterior wall and foundation penetrations.
 - g. Fire-rated wall and floor penetrations.
 - h. Sizes and location of required concrete pads and bases.
 2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
 4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
- G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."
- B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.
- D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

- A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual piping system specification Sections in Division 15 for special joining materials not listed below.
- B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
 - 2. ASME B16.20 for grooved, ring-joint, steel flanges.
 - 3. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.
- D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.
- E. Solder Filler Metal: ASTM B 32.
 - 1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.
 - 2. Alloy Sn50: Tin (50 percent) and lead (50 percent).
 - 3. Alloy E: Tin (approximately 95 percent) and copper (approximately 5 percent), having 0.10 percent maximum lead content.
 - 4. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10 percent maximum lead content.
 - 5. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10 percent maximum lead content.
 - 6. Alloy Sb5: Tin (95 percent) and antimony (5 percent), having 0.20 percent maximum lead content.
- F. Brazing Filler Metals: AWS A5.8.
 - 1. BCuP Series: Copper-phosphorus alloys.
 - 2. BAg1: Silver alloy.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- H. Solvent Cements: Manufacturer's standard solvents complying with the following:
 - 1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
 - 2. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM F 493.
 - 3. Poly(Vinyl Chloride) (PVC): ASTM D 2564.
 - 4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.
- I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.
- J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.
- K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

- A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.
 - 1. Inside Diameter: Closely fit around pipe, tube, and insulation.
 - 2. Outside Diameter: Completely cover opening.
 - 3. Cast Brass: One-piece, with set-screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome plate.
 - 4. Cast Brass: Split casting, with concealed hinge and set-screw.
 - a. Finish: Rough brass.
 - b. Finish: Polished chrome plate.
 - 5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
 - 6. Stamped Steel: One-piece, with spring clips and chrome-plated finish.
 - 7. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
 - 8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
 - 9. Stamped Steel: Split plate, with exposed-rivet hinge, set-screw, and chrome-plated finish.
 - 10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
 - 11. Cast-Iron Floor Plate: One-piece casting.
- B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.
 - 1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
 - 2. Insulating Material: Suitable for system fluid, pressure, and temperature.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
 4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
 5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.
 6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
 7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225 deg F temperature.
- C. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.
- D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
 2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
 3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
 4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.
 - a. Penetrating Pipe Deflection: 5 percent without leakage.
 - b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
 - c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
 - d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.
 5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with set-screws.
 6. PVC Plastic: Manufactured, permanent, with nailing flange for attaching to wooden forms.
 7. PVC Plastic Pipe: ASTM D 1785, Schedule 40.
 8. PE Plastic: Manufactured, reusable, tapered, cup-shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

2.4 IDENTIFYING DEVICES AND LABELS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.
- B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
 - 2. Location: An accessible and visible location.
- C. Stencils: Standard stencils, prepared for required applications with letter sizes conforming to recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch -high letters for ductwork and not less than 3/4-inch -high letters for access door signs and similar operational instructions.
 - 1. Material: Fiberboard.
 - 2. Material: Brass.
 - 3. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
 - 4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.
- D. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid snap-on, color-coded pipe markers, conforming to ASME A13.1.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.
- F. Plastic Duct Markers: Manufacturer's standard laminated plastic, color coded duct markers. Conform to following color code:
 - 1. Green: Cold air.
 - 2. Yellow: Hot air.
 - 3. Yellow/Green: Supply air.
 - 4. Blue: Exhaust, outside, return, and mixed air.
 - 5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
 - 6. Nomenclature: Include following:
 - a. Direction of air flow.
 - b. Duct service (supply, return, exhaust, etc.).
 - c. Duct origin (from).
 - d. Duct destination (to).
 - e. Design cfm.
- G. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine subcore, except when other colors are indicated.
 - 1. Fabricate in sizes required for message.
 - 2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
 - 3. Punch for mechanical fastening.
 - 4. Thickness: 1/16 inch, except as otherwise indicated.
 - 5. Thickness: 1/8 inch, except as otherwise indicated.
 - 6. Thickness: 1/16 inch for units up to 20 square inches or 8 inches long; 1/8 inch for larger units.
 - 7. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- H. Plastic Equipment Markers: Laminated-plastic, color-coded equipment markers. Conform to following color code:
1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Yellow/Green: Combination cooling and heating equipment and components.
 4. Brown: Energy reclamation equipment and components.
 5. Blue: Equipment and components that do not meet any of the above criteria.
 6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
 7. Nomenclature: Include following, matching terminology on schedules as closely as possible:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.
 8. Size: Approximately 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.
- I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.
1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.5 GROUT

- A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

- A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 15 specify piping installation requirements unique to the piping system.
- B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- C. Install piping at indicated slope.
- D. Install components having pressure rating equal to or greater than system operating pressure.
- E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping free of sags and bends.
- G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install fittings for changes in direction and branch connections.
- L. Install couplings according to manufacturer's printed instructions.
- M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
 - 2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.
- N. Sleeves are not required for core drilled holes.
- O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.
- P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.
- Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.
 - 2. Build sleeves into new walls and slabs as work progresses.
 - 3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- a. PVC Pipe Sleeves: For pipes smaller than 6 inches.
 - b. Steel Pipe Sleeves: For pipes smaller than 6 inches.
 - c. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
 - d. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal."
- 1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.
4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Division 7 Section "Joint Sealants."
- R. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
 1. Install steel pipe for sleeves smaller than 6 inches.
 2. Install cast-iron wall pipes for sleeves 6 inches and larger.
 3. Assemble and install mechanical seals according to manufacturer's printed instructions.
- S. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.
- T. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.
- U. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material. Firestopping materials are specified in Division 7 Section "Firestopping."
- V. Verify final equipment locations for roughing in.
- W. Refer to equipment specifications in other Sections for roughing-in requirements.
- X. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.
 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
 4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:
 - a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- c. Align threads at point of assembly.
 - d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 - e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- 6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
- 7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- 8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
 - a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
 - b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
 - c. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
 - d. Poly(Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
 - e. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
 - f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.
- 9. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to manufacturer's printed instructions.
 - a. Plain-End Pipe and Fittings: Butt joining.
 - b. Plain-End Pipe and Socket-Type Fittings: Socket joining.
- Y. Piping Connections: Except as otherwise indicated, make piping connections as specified below.
 - 1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
 - 2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
 - 3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

- A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
- E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - 1. Stenciled Markers: Complying with ASME A13.1.
 - 2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot noninsulated pipes.
 - 3. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
 - c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
 - d. At access doors, manholes, and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
 - f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
 - g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.
- B. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.
 - 1. Lettering Size: Minimum 1/4-inch -high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch -high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
 - 2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.
- C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.
 - 1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.
- D. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.4 PAINTING AND FINISHING

- A. Refer to Division 9 Section "Painting" for field painting requirements.
- B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

SECTION 230500 – COMMON WORK RESULT FOR HVAC

3.5 CONCRETE BASES

- A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 DEMOLITION

- A. Disconnect, demolish, and remove work specified under Division 15 and as indicated.
- B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
- C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.
- D. Abandoned Work: Cut and remove buried pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap and patch surface to match existing finish.
- E. Removal: Remove indicated equipment from the Project site.
- F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair cut surfaces to match adjacent surfaces.

3.10 GROUTING

SECTION 230500 – COMMON WORK RESULT FOR HVAC

- A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms for placement of grout, as required.
- D. Avoid air entrapment when placing grout.
- E. Place grout to completely fill equipment bases.
- F. Place grout on concrete bases to provide a smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 230522

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes hangers and supports for mechanical systems piping and equipment.

1.3 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

- A. Design seismic restraint hangers and supports, for piping and equipment.
- B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

1.5 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 hanger and support.
- C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.
- F. Licensed Engineer's hanger and support drawings specified in the "Quality Assurance" Article.
- G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.
- D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.
 - 1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.
- F. Licensed Engineer: Prepare hanger and support design drawings, and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.
 - 1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
 - 2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
- B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.
- C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
- D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger requirements are specified in the Section specifying the equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 HANGER AND SUPPORT INSTALLATION

- A. General: Comply with MSS SP-69 and SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.
- C. Install supports with maximum spacings complying with MSS SP-69.
- D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.
- F. Install concrete inserts in new construction prior to placing concrete.
- G. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

- J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- K. Support fire protection systems piping independent of other piping.
- L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 "Building Services Piping" is not exceeded.
- O. Insulated Piping: Comply with the following installation requirements.
 - 1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105
 - 4. Pipes 8 Inches and Larger: Include wood inserts.
 - 5. Insert Material: Length at least as long as the protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.7 FIELD QUALITY CONTROL

- A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

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 vibration isolators, vibration isolation bases, vibration isolation roof curbs, and seismic restraints and snubbers.

1.3 SUBMITTALS

- A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.
- B. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:
 - 1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
 - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
 - 3. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.

1.4 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the 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 vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.

1.5 PROJECT CONDITIONS

- A. Project seismic zone is 4 with a zone factor of 0.40.
- B. Building Importance Factor: 1.5.

1.6 COORDINATION

- A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

SECTION 230548 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Sections.

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. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. Apex Molded Products Co.
4. B-Line Systems, Inc.
5. Bramec Corp.
6. California Dynamics Corp.
7. Cannon Fabrication, Inc.
8. Diversitech Corp.
9. Fabreeka International, Inc.
10. GMT International Corp.
11. Greene Rubber Co.
12. Isolation Technology, Inc.
13. Karman Rubber.
14. Kinetics Noise Control, Inc.
15. King, H.A., Ltd.
16. Lord Industrial Products.
17. Mason Industries, Inc.
18. Metalastik, Inc.
19. Minor Rubber Co., Inc.
20. Rubatex Corp.
21. Service Rubber Group, Inc.
22. Stock Drive Products.
23. Tech Products Corp.
24. Vibration Eliminator Co., Inc.
25. Vibration Isolation Co., Inc.
26. Wagner Products Corp.

2.2 VIBRATION ISOLATORS

- A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.
 1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
 2. Fiberglass or Cork Isolator Pads: Molded cork or glass fiber not less than 1 inch thick and precompressed through 10 compression cycles at 3 times the rated load.
 3. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.
- B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

SECTION 230548 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

- C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig.
 - 6. Top Plates: Provide threaded studs for fastening and leveling equipment.
 - 7. Finishes: Manufacturer's standard corrosive-resistant finish.
- D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.
 - 1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.
- E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.
- F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.
 - 1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.3 SEISMIC CONTROLS

- A. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.
 - 1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.

SECTION 230548 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.
- B. Manufactured Seismic Snubbers: All-directional, double-acting snubbers.
1. Construction: Interlocking steel members restrained by a 3/4-inch-thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch clearance in all directions between rigid and resilient surfaces.
- C. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.
1. Construction: Welded steel shapes conforming to ASTM A 36.
 2. Resilient Components: 3/4-inch-thick, replaceable, shock-absorbing neoprene insert.

2.4 VIBRATION ISOLATION BASES

- A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.
1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
 2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
 3. Concrete-Filled Inertia Bases: Weld reinforcing bars to the structural frame. Pour concrete into base with relocated equipment anchor bolts.
 4. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
 5. Configure inertia bases to accommodate equipment supported.
 6. Pump Bases: Size to support pump and piping elbows.
 7. Factory Finish: Manufacturer's standard corrosive-resistant finish.

2.5 VIBRATION ISOLATION ROOF CURBS

- A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.
- B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.
1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer stripe for attachment of roof material and 2 inches of rigid insulation on the inside of the assembly.
 2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad.

SECTION 230548 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.
- B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
- C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.
- D. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete, and trowel to a smooth, hard finish. Cast-in-place concrete is specified in Division 3.
- E. Install pipe connectors at connections for equipment supported on vibration isolators.

3.2 SEISMIC CONTROL

- A. Vibration Isolation Bases: Mount equipment on structural-steel bases or concrete inertia bases.
- B. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

3.3 ADJUSTING AND CLEANING

- A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.
- B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop.

END OF SECTION 230548

SECTION 232300 - REFRIGERANT PIPING

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 refrigerant piping used for air-conditioning applications, including pipes, tubing, fittings, and specialties; special-duty valves; and refrigerants.

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 valve type and refrigerant piping specialty specified.
- C. Shop Drawings showing layout of refrigerant piping, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
 - 1. Refrigerant piping indicated is schematic only. Size and design the layout and installation of the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment.
- D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.
- E. Maintenance data for refrigerant valves and piping specialties to include in the operation and maintenance manual specified in Division 1 Sections and Division 15 Section "Basic Mechanical Requirements."

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with provisions of the following codes:
 - 1. ASME B31.5, "Refrigeration Piping."
 - 2. ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."
- D. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.

1.5 SEQUENCING AND SCHEDULING

SECTION 232300 - REFRIGERANT PIPING

- A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

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 describing contents.
 - 1. Refrigeration Oil Test Kits: 2 each, containing everything required to conduct 1 test.
 - 2. Refrigerant: 2 containers each, with 20 lb of refrigerant.
 - 3. Filter-Dryer Cartridges: 3 of each type.

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. Refrigerants:
 - a. Allied Signal Inc.; Genetron Refrigerants.
 - b. DuPont Company; Fluorochemicals Div.
 - c. Elf Atochem North America, Inc.
 - d. ICI Americas Inc.; Fluorochemicals Bus.
 - 2. Refrigerant Valves and Specialties:
 - a. Danfoss Electronics, Inc.
 - b. Eaton Corporation; Industrial Control Div.
 - c. Emerson Electric Company; Alco Controls Div.
 - d. Henry Valve Company.
 - e. Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
 - f. Sporlan Valve Company.

2.2 PIPES AND TUBES

- A. Soft Copper Tube: ASTM B 88, Type L, annealed temper.

2.3 PIPE AND TUBE FITTINGS

- A. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).
- B. Welding Materials: Comply with ASME Boiler and Pressure Vessel Code Section II, Part C, for welding materials appropriate for pipe being welded.

2.5 VALVES

SECTION 232300 - REFRIGERANT PIPING

- A. Diaphragm Packless Valves: 500-psig working pressure and 275 deg F working temperature, globe or angle pattern, forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, with solder-end connections.
- B. Packed-Angle Valves: 500-psig working pressure and 275 deg F working temperature, forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, with solder-end connections.
- C. Check Valves--Smaller than 1-Inch NPS: 500-psig operating pressure, 300 deg F operating temperature; cast-brass body, with removable piston, PTFE seat, and stainless-steel spring; straight-through globe design. Valve shall be straight-through pattern, with solder-end connections.
- D. Check Valves--Larger than 1-Inch NPS: 450-psig operating pressure, 300 deg F operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained PTFE seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.
- E. Service Valves: 500-psig pressure rating, forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, with solder-end connections.
- F. Solenoid Valves: Conform to ARI 760; 250 deg F temperature rating, 400-psig working pressure; forged brass, with PTFE valve seat, 2-way straight-through pattern, and solder-end connections; manual operator; with NEMA 250, Type 1 solenoid enclosure with 1/2-inch conduit adapter, and 24-V normally closed holding coil.
- G. Pressure Relief Valves: Straight or angle brass body and disc, neoprene seat, factory sealed and ASME labeled, for standard pressure setting.
- H. Thermal Expansion Valves: Conform to ARI 750; thermostatic-adjustable, modulating type; size as required and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

2.6 REFRIGERANT PIPING SPECIALTIES

- A. Straight- or Angle-Type Strainers: 430-psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen, and screwed cleanout plug, with solder-end connections.
- B. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.
- C. Permanent Filter-Dryer: 350-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.
- D. Flexible Connectors: 500-psig operating pressure; seamless tin-bronze or stainless-steel core, high-tensile bronze-braid covering, solder-end connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inches long.

2.7 REFRIGERANT

- A. ASHRAE 34, R-22: Monochlorodifluoromethane.

SECTION 232300 - REFRIGERANT PIPING

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Aboveground, within Building: Type L drawn-copper tubing.
- B. Belowground for 2-Inch NPS and Smaller: Type L annealed-copper tubing.
- C. Belowground for Larger than 2-Inch NPS: Type K annealed-copper tubing.

3.3 INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."
- C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Belowground, install copper tubing in conduit. Vent conduit outdoors.
- G. Insulate suction lines and liquid lines, but insulate them together if adjacent.
 - 1. Do not install insulation until system testing has been completed and all leaks have been eliminated.
- H. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.
- I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- J. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.

SECTION 232300 - REFRIGERANT PIPING

3. Install traps and double risers where indicated and where required to entrain oil in vertical runs.
 4. Liquid lines may be installed level.
- K. Use fittings for changes in direction and branch connections.
- L. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- M. Reduce pipe sizes using eccentric reducer fittings installed with level side down.
- N. Provide bypass around moisture-liquid indicators in lines larger than 2-inch NPS.
- O. Install unions to allow removal of solenoid valves, pressure-regulating valves, expansion valves, and at connections to compressors and evaporators.
- P. Install flexible connectors at the inlet and discharge connection, at right angles to axial movement of compressor, parallel to crankshaft.
- Q. Install replaceable-core filter-dryers, with isolation valves and valved bypass.
- R. Install refrigerant valves according to manufacturer's written instructions.
- S. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.
- T. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.
- U. Mount thermostatic expansion valves in any position, close to evaporator.
1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
 2. Install valve so diaphragm case is warmer than bulb.
 3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
 4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- V. Install pressure relief valves as required by ASHRAE 15. Pipe pressure relief valves on receivers to outdoors.
- W. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.
- X. Charge system as follows:
1. Install filter-dryer core after leak test, but before evacuation.
 2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg F is indicated on vacuum dehydration indicator.
 3. Maintain vacuum for a minimum of 5 hours.
 4. Break vacuum with refrigerant gas and charge to 2 psig.

SECTION 232300 - REFRIGERANT PIPING

3.4 HANGERS AND SUPPORTS

- A. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
- B. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
- C. Pipe rollers for multiple horizontal runs, 20 feet or longer supported by a trapeze.
- D. Spring hangers to support vertical runs.
- E. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.
 - 1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
 - 4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.
 - 5. 1-1/2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. 2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. 2-1/2 Inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 9. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- F. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

- A. Basic pipe and tube joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.

3.6 VALVE INSTALLATIONS

- A. Install refrigerant valves according to manufacturer's written instructions.
- B. Install valves on suction and discharge of compressor, for gage taps at compressor inlet and outlet, for gage taps at hot-gas bypass regulators, on inlet and outlet, and on each side of strainers.
- C. Install check valves on compressor discharge and on condenser liquid lines on multiple condenser systems.
- D. Install refrigerant-charging (packed-angle) valve in liquid line between receiver shutoff valve and expansion valve.
- E. Install globe valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- F. Install a full-sized, 3-valve bypass around each dryer.
- G. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

SECTION 232300 - REFRIGERANT PIPING

1. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.
- H. Mount thermostatic expansion valves in any position, close to evaporator.
 1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
 2. Install valve so diaphragm case is warmer than bulb.
 3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
 4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- I. Install pressure-regulating and relief valves as required by ASHRAE 15.

3.7 SPECIALTIES APPLICATION AND INSTALLATION

- A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.
- B. Install strainers immediately upstream of each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.
- C. Install strainers on main liquid line where multiple expansion valves with integral strainers are used.
- D. Install strainers in suction line of steel pipe.
- E. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.
- F. Install pressure relief valves on ASME receivers, and pipe to outdoors.
- G. Install replaceable-core filter-dryers in vertical liquid line adjacent to receivers and before each solenoid valve.
- H. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.
- I. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.
- J. Install receivers on systems 5 tons and larger, and on systems with long piping runs, sized to accommodate pump-down charge.
- K. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

3.8 CONNECTIONS

- A. Electrical: Conform to applicable requirements of Division 16 Sections for electrical connections.

SECTION 232300 - REFRIGERANT PIPING

3.9 FIELD QUALITY CONTROL

- A. Inspect and test refrigerant piping according to ASME B31.5, Chapter VI.
 - 1. Pressure test with nitrogen to 200 psig. Perform final tests at 27-psig vacuum and 200 psig using halide torch or electronic leak detector. Test to no leakage.
- B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
- C. Repair leaks using new materials; retest.

3.10 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

3.11 CLEANING

- A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.12 COMMISSIONING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryer after leak test, but before evacuation.
 - 2. Evacuate refrigerant system with vacuum pump until temperature of 35 deg F is indicated on vacuum dehydration indicator.
 - 3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
 - 4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
 - 5. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 - 6. Complete charging of system, using new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Division 15 Sections apply to this section:
 - 1. "Basic Mechanical Requirements."
 - 2. "Basic Mechanical Materials and Methods."

1.2 SUMMARY

- A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gage.

1.3 DEFINITIONS

- A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:
 - 1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
 - 2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:
 - 1. Sealing Materials.
 - 2. Fire-Stopping Materials.
- C. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

SECTION 233113 - METAL DUCTS

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
 3. Fittings.
 4. Reinforcing details and spacing.
 5. Seam and joint construction details.
 6. Penetrations through fire-rated and other partitions.
 7. Terminal unit, coil, and humidifier installations.
 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- D. Coordination drawings for ductwork installation in accordance with Division 15 Section "Basic Mechanical Requirements." In addition to the requirements specified in "Basic Mechanical Requirements" show the following:
1. Coordination with ceiling suspension members.
 2. Spatial coordination with other systems installed in the same space with the duct systems.
 3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.
- F. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.
- G. Maintenance data for volume control devices, fire dampers, and smoke dampers, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.
- 1.6 QUALITY ASSURANCE
- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."
- B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- C. NFPA Compliance: Comply with the following NFPA Standards:
1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
 2. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.
- D. Field-Constructed Mock-Up: Prior to installation of duct systems erect mock-ups representing duct systems pressure classifications greater than 2 inches. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.

SECTION 233113 - METAL DUCTS

1. Locate mock-ups on the site. Mock-up may be a representative section of the actual duct system.
2. Include the minimum number of each of the following features and fittings:
 - a. Five transverse joints.
 - b. One access door.
 - c. Two typical branch connections each with at least one elbow.
 - d. Two typical flexible duct or flexible connector connections for each type duct and apparatus.
3. Perform tests specified in "Field Quality Control." Modify mock-up construction and perform additional tests as required to achieve specified minimum acceptable results.
4. Obtain approval of mock-ups before beginning final fabrication.
5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle sealant fire-stopping materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.
- B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SEALING MATERIALS

- A. Joint and Seam Sealants, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
- B. Joint and Seam Tape: 2 inches wide, glass-fiber-fabric reinforced.
- C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.
- D. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.

SECTION 233113 - METAL DUCTS

- E. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 FIRE-STOPPING

- A. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
 - 2. "Pensil 851"; General Electric Co.
 - 3. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
 - 4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
 - 5. "RTV 7403"; General Electric Co.
 - 6. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.
- B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
 - 1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
 - 1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.

2.5 RECTANGULAR DUCT FABRICATION

- A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
 - 1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

SECTION 233113 - METAL DUCTS

2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Fabricate kitchen hood exhaust ducts with 16-gage, carbon steel sheets for concealed ducts and 18-gage stainless steels for exposed ducts. Weld and flange seams and joints. Conform to NFPA Standard 96.
- C. Fabricate dishwasher hood exhaust ducts with 18-gage stainless steels. Weld and flange seams and joints.
- D. Acid-Resistant Ducts: Provide factory-fabricated ducts and fittings only; no shop or field fabrication will be allowed. Refer to PVC-Coated Galvanized Steel Sheets in this Section for materials.
- E. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:
 1. Supply Ducts: 3 inches water gage.
 2. Return Ducts: 2 inches water gage, negative pressure.
 3. Exhaust Ducts: 2 inches water gage, negative pressure.
- F. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-4, unless they are lined or are externally insulated.

2.6 RECTANGULAR DUCT FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.

2.7 ROUND AND FLAT OVAL DUCT FABRICATION

- A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
- B. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 3-1, RL-1, RL-4, or RL-5. Seams Types RL-2 or RL-3 may be used if spot-welded on 1-inch intervals. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

2.8 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.

SECTION 233113 - METAL DUCTS

- C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:
1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.
 - a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
 - b. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
 - 1) 3 to 26 inches: 24 gage.
 - 2) 27 to 36 inches: 22 gage.
 - 3) 37 to 50 inches: 20 gage.
 - 4) 52 to 60 inches: 18 gage.
 - 5) 62 to 84 inches: 16 gage.
 - c. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:
 - 1) 3 to 14 inches: 24 gage.
 - 2) 15 to 26 inches: 22 gage.
 - 3) 27 to 50 inches: 20 gage.
 - 4) 52 to 60 inches: 18 gage.
 - 5) 62 to 84 inches: 16 gage.
 - d. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.
 - e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.
 2. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
 3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
 4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
 5. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gage with 2-piece welded construction.
 6. Round Gored Elbows Gages: Same as for nonelbow fittings specified above.
 7. Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.
 8. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gage.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

SECTION 233113 - METAL DUCTS

- A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.
- B. Install ducts with the fewest possible joints.
- C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- H. Install insulated ducts with 1-inch clearance outside of insulation.
- I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.2 KITCHEN HOOD EXHAUST DUCT INSTALLATIONS

- A. Provide for thermal expansion of ductwork through 2,000-deg F temperature range.
- B. Install without dips or traps that may collect residues, except where traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at 50-foot intervals. Locate on sides of duct 1-1/2 inches minimum from bottom, and fit with grease-tight covers of same material as duct.
- D. Do not penetrate fire-rated assemblies.

3.3 DISHWASHER EXHAUST DUCT INSTALLATIONS

- A. Install dishwasher exhaust duct systems in accordance with SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 2-21.

SECTION 233113 - METAL DUCTS

3.4 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints as follows:
- B. Pressure Classifications Greater Than 3 Inches Water Gage: All transverse joints, longitudinal seams, and duct penetrations.
- C. Pressure Classification 2 and 3 Inches Water Gage: All transverse joints and longitudinal seams.
 - 1. Pressure Classification Less than 2 Inches Water Gage: Transverse joints only.
- D. Seal externally insulated ducts prior to insulation installation.

3.5 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.
- B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 feet and at each floor.
- D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.
- E. Install concrete insert prior to placing concrete.
- F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.6 CONNECTIONS

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 15 Section "Duct Accessories."
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.
- D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.

3.7 FIELD QUALITY CONTROL

- A. The Owner will contract with an independent testing agency to perform, record, and report leakage tests.
- B. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

SECTION 233113 - METAL DUCTS

3.8 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 15 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 233113

SECTION 233423 – HVAC POWER VENTILATORS

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. Centrifugal roof ventilators.
 - 2. Centrifugal wall ventilators.
 - 3. Ceiling-mounted ventilators.
 - 4. In-line centrifugal fans.
- B. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on sea-level conditions.
- B. Operating Limits: Classify according to AMCA 99.
- C. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.
 - 1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
 - 2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

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 rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound power ratings.
 - 3. Motor ratings and electrical characteristics plus motor and electrical accessories.
 - 4. Material gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

SECTION 233423 – HVAC POWER VENTILATORS

- D. Coordination Drawings, according to Division 15 Section "Basic Mechanical Requirements," for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:
 - 1. Roof framing and support members relative to duct penetrations.
 - 2. Ceiling suspension assembly members.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- E. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
- F. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 1 and in Division 15 Section "Basic Mechanical Requirements."

1.5 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
- B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
 - 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.
- C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.
- D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.
- E. UL Standard: Provide power ventilators that comply with UL 705.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements. Verify clearances.
- B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate the size and location of structural steel support members.
- B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

1.8 EXTRA MATERIALS

SECTION 233423 – HVAC POWER VENTILATORS

- A. Furnish one set of belts for each belt-driven fan that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

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. Centrifugal Roof Ventilators:

- a. Ammerman Company, Inc.
- b. Broan Mfg. Co., Inc.
- c. Carnes Co.
- d. Central Blower Co.
- e. Cincinnati Fan & Ventilator Co.
- f. Cook (Loren) Co.
- g. Essick Air Products, Breidert.
- h. Greenheck Fan Corp.
- i. ILG Industries, Inc.
- j. Jenn Industries Inc.
- k. Lau Division Philips Industries, Inc.
- l. Quietaire Corp.

- 2. Centrifugal Wall Ventilators:

- a. Ammerman Company, Inc.
- b. Broan Mfg. Co., Inc.
- c. Carnes Co.
- d. Chelsea Fans & Blowers, Inc.
- e. Cook (Loren) Co.
- f. Greenheck Fan Corp.
- g. ILG Industries, Inc.
- h. Jenn Industries Inc.

- 3. Ceiling-Mounted Ventilators:

- a. Ammerman Company, Inc.
- b. Broan Mfg. Co., Inc.
- c. Carnes Co.
- d. Chelsea Fans & Blowers, Inc.
- e. Cook (Loren) Co.
- f. Greenheck Fan Corp.
- g. Essick Air Products, Breidert.
- h. FloAire, Inc.
- i. ILG Industries, Inc.
- j. Jenn Industries Inc.

- 4. In-Line Centrifugal Fans:

- a. Cook (Loren) Co.
- b. FloAire, Inc.
- c. Greenheck Fan Corp.

SECTION 233423 – HVAC POWER VENTILATORS

- d. ILG Industries, Inc.
- e. Jenn Industries Inc.

2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust air stream.
- E. Accessories: The following items are required as indicated:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
 - 3. Bird Screens: Removable 1/2-inch mesh, aluminum or brass wire.
 - 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - 5. Roof Curbs: Galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 2-inch wood nailer. Size as required to suit roof opening and fan base.
 - a. Configuration: Self-flashing without a cant strip, with mounting flange.
 - b. Configuration: Built-in cant and mounting flange.
 - c. Configuration: Built-in raised cant and mounting flange.
 - d. Overall Height: 8 inches.
 - e. Overall Height: 12 inches.
 - f. Overall Height: 18 inches.

2.3 CENTRIFUGAL WALL VENTILATORS

- A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

SECTION 233423 – HVAC POWER VENTILATORS

- D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust air stream.
- E. Accessories: The following items are required as indicated:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 4. Wall Grille: Ring type for flush mounting.
 - 5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

2.4 CEILING-MOUNTED VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall, or for concealed in-line applications.
- B. Housing: Galvanized steel lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Stainless-steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
- G. Accessories: Manufacturer's standard roof jack or wall cap, and transition fittings.

2.5 IN-LINE CENTRIFUGAL FANS

- A. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.
- B. Housing: Split, spun-aluminum housing, with aluminum straightening vanes; inlet and outlet flanges; and support bracket adaptable to floor, side wall, or ceiling mounting.
- C. Direct-Drive Units: Motor encased in housing out of air stream, factory wired to disconnect located on outside of fan housing.
- D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

SECTION 233423 – HVAC POWER VENTILATORS

- E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- F. Accessories: The following accessories are required as indicated:
 - 1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
 - 2. Companion Flanges: For inlet and outlet duct connections.
 - 3. Fan Guards: Expanded metal in removable frame. Provide belt guards for units not connected to ductwork.

2.6 MOTORS

- A. Refer to Division 15 Section "Motors" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.
- C. Enclosure Type: The following features are required as indicated:
 - 1. Open dripproof motors where satisfactorily housed or remotely located during operation.
 - 2. Guarded dripproof motors where exposed to contact by employees or building occupants.

2.7 FACTORY FINISHES

- A. Sheet Metal Parts: Prime coat before final assembly.
- B. Exterior Surfaces: Baked-enamel finish coat after assembly.
- C. Aluminum Parts: No finish required.

2.8 SOURCE QUALITY CONTROL

- A. Testing Requirements: The following factory tests are required as indicated:
 - 1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
 - 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install power ventilators according to manufacturer's written instructions.

SECTION 233423 – HVAC POWER VENTILATORS

- B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Division 15 Section "Vibration Control."
 - 1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.
 - a. Installation of roof curbs is specified in Division 7 Sections.
 - 2. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
 - 3. Ceiling Units: Suspend units from structure using steel wire or metal straps.
- C. Install units with clearances for service and maintenance.

3.3 HOUSEKEEPING BASES

- A. Construct concrete housekeeping pads as follows:
 - 1. Coordinate size of housekeeping bases with actual unit sizes provided. Construct base 4 inches larger, in both directions, than the overall dimensions of the supported unit.
 - 2. Form concrete pads with steel channels conforming to ASTM A 36, size and location as indicated. Miter and weld corner and provide cross bracing. Anchor or key to floor slab.
 - 3. Form concrete pads with framing lumber with form-release compounds. Chamfer top edge and corners of pad.
 - 4. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
 - 5. Place concrete and allow to cure before installing units. Use portland cement conforming to ASTM C 150, 4000-psi compressive strength, and normal-weight aggregate.
 - 6. Clean exposed steel form according to SSPC Surface Preparation Specifications SP 2 or SP 3 and apply 2 coats of rust-preventive metal primer.

3.4 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Electrical: Conform to applicable requirements in Division 16 Sections.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

SECTION 233423 – HVAC POWER VENTILATORS

- B. Adjust belt tension.
- C. Lubricate bearings.

3.7 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.8 COMMISSIONING

- A. Final Checks before Startup: Perform the following operations and checks before startup:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
 - 7. Disable automatic temperature-control operators.
- B. Starting procedures for fans are as follows:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor voltage and amperage.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.
- E. Replace fan and motor pulleys as required to achieve design conditions.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."
- C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

SECTION 233423 – HVAC POWER VENTILATORS

- D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION 233423

SECTION 233713 – DIFFUSER, REGISTER, AND GRILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Ceiling air diffusers.
 - 2. Wall registers and grilles.
 - 3. Louvers.
- C. Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.
- D. Refer to other Division-15 sections for balancing of air outlets and inlets; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
 - 4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
 - 5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
 - 6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

SECTION 233713 – DIFFUSER, REGISTER, AND GRILLERS

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
- B. Samples: 3 samples of each type of finish furnished.
- C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.
- 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:
- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule.
1. Diffuser Faces:
 - a. Round (RD): Round housing, core of concentric rings, round duct connection.
 - b. Square (SQ): Square housing, core of square concentric louvers, square or round duct connection.
 - c. Rectangular (RCT): Rectangular housing, core of rectangular concentric louvers, square or round duct connection.

SECTION 233713 – DIFFUSER, REGISTER, AND GRILLERS

- d. Perforated (PR): Round, square, or rectangular housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.
 - e. Linear (LR): Extruded aluminum continuous slot, single or multiple.
- 2. Diffuser Mountings:
 - a. Flush (FL): Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
 - b. Lay-In (L-I): Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.
- 3. Diffuser Patterns:
 - a. Fixed (FX): Fixed position core with concentric rings or louvers for radial air flow around entire perimeter of diffuser.
 - b. 1 Way (1-W): Fixed louver face for 1-direction air flow, direction indicated on drawings.
 - c. 2 Way (2-W): Fixed louver face for 2-direction air flow, directions indicated on drawings.
 - d. 3 Way (3-W): Fixed louver face for 3-direction air flow, directions indicated on drawings.
 - e. 4 Way (4-W): Fixed louver face for 4-direction air flow, directions indicated on drawings.
- 4. Diffuser Dampers:
 - a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of diffuser.
 - b. Butterfly (BTFY): Two semicircular flaps connected to linkage adjustable from face of diffuser with key, and with straightening grid.
- 5. Diffuser Accessories:
 - a. Plaster Ring (P-R): Perimeter ring designed to act as a plaster stop and diffuser anchor.
 - b. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at diffuser take-off.
- 6. Diffuser Finishes:
 - a. White Enamel (W-E): Semi-gloss white enamel prime finish.
 - b. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.
- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to, the following:
 - 1. Anemostat Products Div.; Dymanics Corp. of America.
 - 2. Cranes Co.; Div. of Wehr Corp.
 - 3. Krueger Mfg. Co.
 - 4. Titus Products Div.; Philips Industries, Inc.
 - 5. Tuttle & Bailey; Div. of Interpace Corp.

2.2 WALL REGISTERS AND GRILLES:

SECTION 233713 – DIFFUSER, REGISTER, AND GRILLERS

- A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.
- C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.
- D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:
 - 1. Register and Griller Materials:
 - a. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades.
 - 2. Register and Grille Faces:
 - a. Horizontal Straight Blades (H-S): Horizontal blades, individually adjustable, at manufacturer's standard spacing.
 - b. Vertically Straight Blades (V-S): Vertical blades, individually adjustable, at manufacturer's standard spacing.
 - c. Horizontal 45 Degree Fixed Blades (H-45 Degrees): Horizontal blades, fixed at 45 degrees, at manufacturer's standard spacing.
 - 3. Register and Grille Patterns:
 - a. Single Deflection (S-D): 1-set of blades in face.
 - b. Double Deflection (D-D): 2-sets of blades in face, rear set at 90 degrees to face set.
 - 4. Register and Grille Dampers:
 - a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of register.
 - 5. Register and Grille Accessories:
 - a. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at register or grille take-off.
 - b. Plaster Frame (P-F): Perimeter frame designed to act as plaster stop and register or grille anchor.
 - c. Operating Keys (OP-KY): Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustable.
 - 6. Register and Grille Finishes:
 - a. White Enamel (W-E): Semi-gloss white enamel prime finish.
 - b. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.

SECTION 233713 – DIFFUSER, REGISTER, AND GRILLERS

- E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering registers and grilles which may be incorporated in the work include, but are not limited to, the following:

1. Anemostat Products Div.; Dynamics Corp. of America.
2. Carnes Co.; Div. of Wehr Corp.
3. Titus Products Div.; Philips Industries, Inc.

2.3 LOUVERS:

- A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.
- C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.
- D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.
- E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.
- F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering louvers which may be incorporated in the work include, but are not limited to, the following:
1. Airline Products Co.
 2. Airolite Co.
 3. American Warming & Ventilating Inc.
 4. Arrow United Industries, Inc.
 5. Construction Specialties, Inc.
 6. Dowco Corp.
 7. Industrial Louvers, Inc.
 8. Louvers & Dampers, Inc.
 9. Penn Ventilator Co., Inc.
 10. Ruskin Mfg. Co.
 11. Safe-Air Inc.
 12. Snyder (E.G.) Co., Inc.
 13. Vent Products Co., Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

SECTION 233713 – DIFFUSER, REGISTER, AND GRILLERS

3.2 INSTALLATION:

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS:

- A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 233713

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

- A. Section includes:
 - 1. Residential air-cooled condensing units.
 - 2. Air-cooled condensing units.
- B. Related Sections:
 - 1. Section 15530 - Refrigerant Piping

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories; and installation and start-up instructions.
- B. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of condensing units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. Operation and Maintenance Data: Submit maintenance data and parts list for each condensing unit, control, and accessory; including "trouble shooting" maintenance guide; plus servicing, and preventative maintenance procedures and schedule. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of condensing units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Codes and Standards:
 - 1. Capacity ratings for condensing units shall be in accordance with ARI Standard 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".
 - 2. Refrigeration system of condensing units shall be constructed in accordance with ASHRAE Standard ASHRAE 15 "Safety Code for Mechanical Refrigeration".
 - 3. Condensing units shall meet or exceed the minimum COP/Efficiency levels as prescribed in ASHRAE 90A "Energy Conservation in New Building Design".
 - 4. Construction and testing of water cooled condensing units shall be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII.

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

5. Condensing units shall be listed by UL and have UL label affixed.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Handle condensing units and components carefully to prevent damage. Follow manufacturer's written instructions for rigging. Replace damaged condensing units or components.
- B. Store condensing units and components in clean dry place off the ground. Protect from weather, water, and physical damage.

1.6 SPECIAL PROJECT WARRANTY:

- A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 RESIDENTIAL AIR-COOLED CONDENSING UNITS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering residential air-cooled condensing units which may be incorporated in the work include, but are not limited to, the following:
 1. BDP Co; Div Carrier Corp.
 2. Carrier Air Conditioning; Div Carrier Corp.
 3. Fedders Air Conditioning USA; Fedders Corp.
 4. Lennox Industries, Inc.
 5. Trane (The) Co; Div American Standard Inc.
 6. York; Div York International.
- B. General: factory-assembled and tested air-cooled condensing units, consisting of compressor, condenser coil, fan, motor, refrigerant reservoir, and operating controls. Capacity and electrical characteristics are scheduled (on the Drawings) (at the end of this Section).
- C. Casing: galvanized steel finished with baked enamel, complete with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Unit shall be complete with brass service valves, fittings, and gage ports on exterior of casing.
- D. Compressor: hermetically sealed with built-in overloads and vibration isolation. Compressor motor, shall have thermal and current sensitive overload devices, internal high-pressure protection, high and low pressure cutout switches, start capacitor and relay, 2-pole contactor, crankcase heater, and temperature actuated switch and timer to prevent compressor rapid cycle.

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

- E. Condenser: coil shall have copper tubes and aluminum fins, or aluminum tubes and aluminum fins; complete with liquid accumulator and liquid subcooler. Aluminum propeller fan shall be direct driven, with permanently lubricated fan motor having thermal overload protection.
- F. Accessories:
 - 1. Low-voltage thermostat and subbase to control condensing unit and evaporator fan.
 - 2. Precharged and insulated suction and liquid tubing of length indicated.
 - 3. Head pressure control to modulate condenser fan motor speed for low ambient conditions.
 - 4. Heat reclaim device providing preheating of domestic hot water with hot gas from condensing unit.
 - 5. Low-voltage control transformer.
 - 6. Water-to-refrigerant heat exchanger.

2.2 AIR-COOLED CONDENSING UNITS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air-cooled condensing units which may be incorporated in the work include, but are not limited to, the following:
 - 1. BDP Co; Div Carrier Corp.
 - 2. Carrier Air Conditioning; Div of Carrier Corp.
 - 3. McQuay Air Conditioning Group; McQuay Inc.
 - 4. Trane (The) Co; Div American Standard Inc.
 - 5. York; Div of York International.
- B. General: factory-assembled and tested air-cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls. Capacities and electrical characteristics are scheduled (on the Drawings) (at the end of this Section).
- C. Unit Casings: designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include:
 - 1. steel, galvanized or zinc-coated, for exposed casing surfaces, treated and finished with manufacturer's standard paint coating;
 - 2. lifting lugs to facilitate rigging of units;
 - 3. factory-installed metal grilles, for protection of condenser coil during shipping, installation, and operation;
 - 4. hinged and gasketed control panel door.
- D. Compressor: reciprocating hermetic-type compressor, 1,750 RPM, designed for air-cooled condensing, complete with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports. Capacity shall be controlled through cylinder unloading. Additional features include:
 - 1. Crankcase heater in well within crankcase;
 - 2. Capacity steps as scheduled, or greater number;
 - 3. Compressor of same manufacturer as condensing unit.
- E. Controls: Operating and safety controls shall include high and low pressure cutouts, oil pressure cutout, compressor winding thermostat cutout, 3-leg compressor overload protection, and condenser fan motors with thermal and overload cutouts. Control transformer if required

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

shall be 115-volts. Provide magnetic contactors for compressor and condenser fan motors. Additional features include:

1. Reset relay circuit for manual resetting of cutouts from remote thermostat location;
 2. Automatic nonrecycling pumpdown, and timing device to prevent excessive compressor cycling;
 3. Unfused disconnect switch, factory-mounted and wired, for single external electrical power connection.
- F. Condensing Section: Condenser coil shall be seamless copper tubing mechanically bonded to heavy-duty, configured aluminum fins, with separate and independent refrigeration circuit for each compressor. Units shall include liquid accumulator and subcooling circuit, and backseating liquid line service access valve. Condenser coils shall be factory-tested at 450 psig, vacuum dehydrate, and filled with a holding charge of nitrogen.
- G. Condenser fans and drives: propeller-type condenser fans for vertical air discharge; either direct drive or belt drive. Additional features include:
1. Permanent lubricated ball bearing condenser fan motors;
 2. Separate motor for each condenser fan;
 3. Constant speed condenser fan motors;
 4. Each fan assembly shall be dynamically and statically balanced.
- H. Low ambient control: factory-installed low ambient damper assembly, fan speed control, or fan cycling control.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verify roof structure, mounting supports, and membrane installations are completed to the proper point to allow installation of roof mounted units. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. General: Install condensing units in accordance with manufacturers installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support:
- C. Install ground-mounted units on 4 inches thick reinforced concrete pad, 4 inches larger on each side than condensing unit. Concrete is specified in Division 3. Coordinate installation of anchoring devices.
- D. Install roof-mounted units on equipment supports specified in Division 7. Anchor unit to supports with removable fasteners.
- E. Residential Units: Connect pre-charged refrigerant tubing to unit's quick-connect fittings. Run tubing so as not to interfere with access to unit.
1. Install furnished accessories.

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

- F. Air-Cooled Condensing Units: Connect refrigerant piping to unit; maintain required access to unit.

- 1. Install furnished field-mounted accessories.

3.3 FIELD QUALITY CONTROL:

- A. Testing:
- B. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

3.4 DEMONSTRATION:

- A. Provide services of manufacturer's authorized service representative to provide start-up service and to instruct Owner's personnel in operation and maintenance of condensing units.
- B. Start-up condensing units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- C. Train Owner's personnel on start-up and shut-down procedures, troubleshooting procedures, servicing, and preventative maintenance schedule and procedures. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division One.
 - 1. Schedule training with Owner, provide at least 7-day prior notice to Architect/Engineer.

END OF SECTION 236200

SECTION 238223 - UNIT VENTILATORS

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 ventilators with the following cooling elements:

- 1. Chilled-water cooling coil.
- 2. Refrigerant cooling coil.

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. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
- D. Samples of cabinet finish colors for approval.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Field test reports from a qualified independent inspecting and testing agency indicating and interpreting test results relative to compliance with performance requirements of unit ventilators.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing unit ventilators similar to those indicated for this Project and that have a record of successful in-service performance.
- B. Comply with ARI 440 for testing and rating units.
- C. Comply with ASHRAE 33 for testing steam and hydronic coils.
- D. Comply with NFPA 70 for components and installation.
- E. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 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.

SECTION 238223 - UNIT VENTILATORS

1.5 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. Unit Ventilator Filters: Furnish one spare filter for each filter 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. ABB Aerovent Inc.
 - 2. York
 - 3. Carrier
 - 4. The Trane Co.

2.2 MATERIALS

- A. Cabinet: Galvanized steel with removable panels on front and ends.
- B. Coil Section Insulation: Faced, heavy-density, glass-fiber insulation over entire section.
- C. Adjustable discharge vanes located beneath discharge grilles.
- D. Removable inlet grilles.
- E. Drain Pans: Galvanized steel, with connection for drain. Drain pan insulated with polystyrene or polyurethane insulation.
- F. Plastic Laminate Top Surface: Color and pattern as selected by Architect.
- G. Cabinet Finish: Metal surfaces filled, coated with baked-on primer, and finished with manufacturer's standard baked enamel; color as selected by Architect.

2.3 COMPONENTS

- A. Unitary Refrigeration Chassis: Condensing unit with suction line accumulator, antislugging devices, crankcase heater, filter, drier, winding thermal protection, overcurrent protection, pressure-limiting valve, and operating controls.
 - 1. Refrigeration Coils: 2-row copper tubes with aluminum fins, conforming to ARI 210. Include thermal expansion valve.
 - 2. Exterior Louver: Extruded aluminum sized to refrigeration unit capacity by manufacturer.
- B. Hydronic Cooling Coils: Fin-and-tube coil fabricated of copper, with copper or aluminum fins spaced no closer than 0.1 inch, rated 200 psig. Leak test to 300 psig underwater.

SECTION 238223 - UNIT VENTILATORS

- C. Fan and Motor: Centrifugal blower, direct driven by a single phase, 2-speed, electric motor with inherent overload protection and resilient motor/fan mount.
- D. Wiring Terminations: Match conductor materials and sizes indicated.
- E. Filter: Manufacturer's standard throwaway filter, 1 inch thick, on inlet of each fan.
- F. Automatic Temperature Controls: Refer to Division 15 Sections.
- G. Safety Devices: Each unit has the following safety devices:
 - 1. Manual disconnect switch completely deenergizes unit.
 - 2. Spring-loaded interlock switch deenergizes control circuit and deenergizes fan and heating elements when front panel is removed.
 - 3. Heat-dissipation switch keeps fans running when unit discharge temperature rises above 100 deg F.
 - 4. Overcurrent protection fuses.
 - 5. Branch circuit fusing to protect heating-element subdivision circuits (maximum 48 A).
 - 6. Motor and control circuit fuses.
 - 7. Low-temperature, cut-out thermostat strapped to air coil prevents coil from freezing and liquid from slugging.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and supports to receive unit ventilators for compliance with requirements for installation tolerances and other conditions affecting performance of unit ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install unit ventilators as indicated, to comply with manufacturer's written instructions and NFPA 90A.
- B. Connect unit ventilators and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.
- C. Connect fan-coil unit ventilators to hydronic piping according to Division 15 Section "Hydronic Piping." Provide shutoff valve and union or flange at each connection.

3.3 FIELD QUALITY CONTROL

- A. Testing: After installing unit ventilators and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- B. Remove and replace malfunctioning units with new units, and retest.

SECTION 238223 - UNIT VENTILATORS

3.4 CLEANING

- A. Replace filters in each unit ventilator.

3.5 COMMISSIONING

- A. Startup Services: Engage a factory-authorized service representative to provide startup service.
- B. Operate fan motor to verify proper rotation.
- C. Operate electric heating elements through each stage to verify proper operation and electrical connections.
- D. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

END OF SECTION 238223

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 PRODUCTS

1.1 MATERIALS

- A. Common Work Results for Electrical:
1. Medium-Voltage Cables:
 - a. Single and Multiple Conductor Types: UL 1072.
 - b. Cable: Cross-linked polyethylene, XLP, insulated, NEMA WC 7.
 - c. Cable: Ethylene propylene rubber, EPR, insulated, NEMA WC 8.
 - d. Conductors: Class B stranded, annealed copper.
 - e. Conductors: Class B stranded, aluminum.
 - f. Cable Jacket: PVC.
 - g. Cable Jacket: PVC extruded over metal armor.
 - h. Cable Jacket: Cross-linked polyolefin.
 - i. Metallic Shielding: Copper shielding tape.
 - j. Metallic Shielding: Solid copper wires.
 - k. Cable Voltage Rating: 15 kV phase to phase.
 - l. Insulation Thickness: Corresponding to referenced standard.
 - m. Circuit Identification: Color-coded tape.
 - n. Three-Conductor Cable Assembly: Shield conductors with grounding conductor.
 - o. Type MC Cable Armor: Aluminum interlocked armor.
 - p. Type MC Cable Armor: Galvanized steel interlocked armor.
 - q. Splices, Terminations, Kits, Cable Seals, Junctions: Suitable for service.
 - r. Arc-Proofing Materials: UL fireproofing intumescent tape.
 - s. Fault Indicators: Manual reset fault indicator to clamp to cable sheath.
 2. Low-Voltage Cables:
 - a. Armored Cable: UL Types AC.
 - b. Metal-Clad Cable in Cable Trays: UL Type MC.
 - c. Nonmetallic-Sheathed Cable for Lighting Wiring: UL Type NM and NMC.
 - d. Aboveground Service Entrance Cable: UL Type SE.
 - e. Underground Service Entrance Cable: UL Type USE.
 - f. Underground Feeder and Branch-Circuit Cable: UL Type UF.
 - g. Portable Cord for Flexible Pendant Leads to Outlets and Equipment: UL Type S.
 - h. Control/Signal Transmission Media: Single conductor coaxial type.
 - i. Flat Cabling System for Power Under Carpet Tile: Factory-laminated assembly.
 - j. Flat Cabling System for Tel/Data Transmission Under Carpet Tile: Flat cable.
 - k. Fiber Optic Cables: Single channel low-loss glass type.
 - l. 7.Wire Components:
 - m. Conductors, No. 10 AWG and Smaller: Solid.
 - n. Conductors, No. 8 AWG and Larger: Stranded.
 - o. Insulation: THW, THHN/THWN or XHHW as applicable.
 - p. Jackets: Factory-applied nylon or PVC.
 - q. Conductor Material: Copper.
 - r. Conductor Material: Copper-clad aluminum.
 - s. Conductor Material: Aluminum.
 3. Metal Conduit and Tubing:
 - a. Rigid Aluminum Conduit: ANSI C80.5.
 - b. Rigid Steel Conduit: ANSI C80.1.
 - c. Intermediate Steel Conduit: UL 1242.

- d. PVC Coated Rigid Steel Conduit and Fittings: ANSI C80.1, NEMA RN 1.
- e. Electrical Metallic Tubing (EMT) and Fittings: ANSI C80.3.
- f. PVC Coated Electrical Metallic Tubing and Fittings: ANSI C80.3, NEMA RN 1.
- g. Flexible Metal Conduit: UL 1 aluminum.
- h. Flexible Metal Conduit: UL 1 zinc-coated steel.
- i. Liquidtight Flexible Metal Conduit and Fittings: UL 360.
- 4. Nonmetallic Conduit and Ducts:
 - a. Electrical Nonmetallic Tubing (ENT): NEMA TC 13.
 - b. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 and UL 651, PVC.
 - c. Underground PVC and ABS Plastic Utilities Duct: NEMA TC 6.
 - d. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC 9.
 - e. Liquidtight Flexible Nonmetallic Conduit and Fittings: UL 1660.
- 5. Boxes and Fittings:
 - a. Cabinet Boxes: UL 50, sheet steel, NEMA 1.
 - b. Pull and Junction Boxes: UL 50, steel boxes.
 - c. Metal Outlet, Device and Small Wiring Boxes: UL 514A and OS 1.
 - d. Nonmetallic Outlet, Device and Small Wiring Boxes: NEMA OS 2.
- 6. Raceway Accessory Materials:
 - a. Conduit Bodies: NEC requirements.
 - b. Wireways: NEC requirements.
 - c. Surface Raceways, Metallic: Galvanized steel, with snap-on covers.
 - d. Surface Raceways, Nonmetallic: Rigid PVC, UL 94.
- 7. Cable Trays:
 - a. Materials: Mill galvanized steel.
 - b. Materials: Hot-dip galvanized steel.
 - c. Materials: PVC-coated steel.
 - d. Configuration: Ladder type, trough-type, solid-bottom type, channel type.
 - e. Covers: Solid type, louvered type, and ventilated-hat type.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Provide lighting control devices.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
 - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Lighting Control Devices:
 - 1. Manufacturers: Refer to www.arcat.com/divs/sec/sec13807.html
 - 2. Application: Locations indicated.
 - 3. Sustainable Design: Utility efficient equipment and fixtures.
 - 4. Sustainable Design: Commissioning.
 - 5. Lighting Control Equipment Systems:
 - a. Manual Modular Dimming System: Factory fabricated, 1 to 4 channels.
 - b. Integrated Multi-preset Modular Dimming System: Microprocessor-based.
 - c. Multi-channel Remote-Controlled Dimming System: Microprocessor-based.
 - d. Programmable Lighting Control System: UL 916, microprocessor-based.
 - e. Programmable Lighting Control System: Multiple remote addressable units.
 - 6. Lighting Control Equipment Components:
 - a. Surge Protection: UL 1449 solid-state, line-voltage equipment surge protection.
 - b. Dimmers: UL 508.
 - c. Contactors and Relays: NEMA ICS 2, electrically operated.
 - d. Time Switches and Sensors: UL 917 and UL 773A.
 - e. Occupancy Sensors: UL listed, Class 2, ultrasonic, ceiling-mounted.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform

appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.

- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Provide core drilling as required for new work.
- D. Conceal conduit to the greatest extent practical.
- E. Install light switches at uniform height above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other.
- G. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- H. Test all systems for proper operation. Label circuits in electrical panels.
- I. Restore damaged finishes. Clean and protect work from damage.
- J. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 10 00
MEDIUM-VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. Provide medium-voltage electrical distribution.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used. List project-specific information, including incoming service characteristics, connection types, transformers, and distribution system characteristics if available.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Medium-Voltage Electrical Distribution:
1. Manufacturers: Refer to www.arcad.com/divs/sec/sec16300.html
 2. Application: Locations indicated.
 3. Sustainable Design: Utility efficient equipment and fixtures.
 4. Sustainable Design: Commissioning.
 5. Secondary Unit Substations:
 - a. Secondary Unit Substation Assembly: ANSI C37.121.
 - b. Incoming Line Section: Bushings, terminal chamber, switches and fuses.
 - c. Transformer Section: Liquid filled.
 - d. Transformer Section: Weather-resistant, ventilated, dry type.
 - e. Transformer Section: Cast-coil, dry type.
 - f. Transformer Section: Total enclosed, nonventilated, dry type.
 - g. Outgoing Section: Motor control center type.
 - h. Outgoing Section: Metal enclosed, low-voltage power switchgear.
 - i. Enclosure: NEMA Type 1, general purpose.
 - j. Enclosure: NEMA Type 2, dripproof.
 - k. Enclosure: NEMA Type 3, rainproof and sleet resistant.
 - l. Enclosure Type: Non-walk-in, front accessible.
 - m. Enclosure Type: Non-walk-in, front and rear accessible.
 - n. Enclosure Type: Walk-in aisle.
 6. Medium Voltage Transformers:
 - a. Dry-Type Secondary Substation Type: NEMA ST 20, ANSI/IEEE C.57.12.01.
 - b. Pad-Mounted Type: ANSI/IEEE C57.12.22, C57.12.26.

- c. Liquid-Filled Secondary Substation Type: ANSI/IEEE C57.12.00, C57.12.13.
- 7. Medium Voltage Switchgear:
 - a. Metal-Clad Circuit Breaker Switchgear: ANSI/IEEE C37.20.2.
 - b. Metal-Enclosed Interrupter Switchgear: ANSI/IEEE C37.20.3.
 - c. Switchgear Ratings: Nominal system voltage, main bus continuous amperes.
 - d. Switchgear Load-Interrupter Switches: Stationary mounted, gang operated.
 - e. Switchgear Circuit Breakers: Draw-out mounting with operation at rated voltage.
 - f. Grounding and Test Devices: Suitable for phasing out and testing.
 - g. Switchgear Control Battery and Charger: Control battery, racks, control panel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- C. Test all systems for proper operation. Label circuits in electrical panels. Restore damaged finishes. Clean and protect work from damage.
- D. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 20 00
LOW-VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 PRODUCTS

1.1 MATERIALS

- A. Low-Voltage Electrical Distribution:
1. Low-Voltage Transformers:
 - a. Dry Type Transformers: NEMA ST 20, copper windings.
 - b. Drive Isolation Transformers: NEMA ST 1, UL 506, 2 winding dry type.
 - c. Buck-Boost Transformers: NEMA ST 1, UL 506, self-cooled dry type.
 - d. Control and Signal Transformers: NEMA ST 1, UL 506, self-cooled.
 - e. Voltage Regulating Transformers: ANSI/IEEE C57.15, ventilated, self-cooled.
 - f. Voltage Stabilizing Transformers: NEMA ST 1, UL 506, dry-type, self-cooled.
 - g. Induction Type Voltage Regulator: ANSI/IEEE C57.15, solid state type.
 2. Low Voltage Switchgear Assemblies: IEEE C37.20.1 and UL 1558.
 3. Low Voltage Drawout Power Circuit Breakers: IEEE C37.13 and UL 1066.
 4. Switchboards:
 - a. Utility Metering Compartment: Acceptable to local utility company.
 - b. Buses and Connections: Three-phase, four-wire type.
 - c. Overcurrent Protective Devices (OCPDs): Ratings, settings suitable for use.
 - d. Circuit Control and Protective Devices: Transfer switches, surge arrestors.
 - e. Instrument Transformers: NEMA EI 21.1, IEEE C57.13.
 - f. Ratings: System voltage, main bus amperage, short-circuit-current rating.
 - g. Switchboard Type: Front-connected, front-accessible, panel-mounted branches.
 - h. Switchboard Type: Front and side accessible sections.
 - i. Switchboard Type: Front and rear accessible sections.
 - j. Enclosure: NEMA 1, indoor.
 - k. Enclosure: NEMA 3R, rainproof.
 5. Panelboards:
 - a. Panelboards: NEMA PB 1, UL 50, 61, IEEE C62.1 surge arresters.
 - b. Panelboard Type: Load-center-type panelboards.
 6. Wiring Devices and Components:
 - a. Receptacles: UL 498 and NEMA WD 1.
 - b. Industrial Receptacles: UL 498; UL 1010 at hazardous locations.
 - c. Ground-Fault Interrupter Receptacles: Feed-thru type ground-fault circuit type.
 - d. Isolated Ground Receptacles: Listed and labeled, integral to receptacle.
 - e. Plugs: 15 amperes, 125 volts, 3 wire, grounding, armored cap plugs.
 - f. Plug Connectors: 1bakelite-body armored connectors, 3 wire grounding unit.
 - g. Snap Switches: UL 20 and NEMA WD 1, AC switches.
 - h. Combination Switch and Receptacles: 3-way switch, grounding receptacle.
 - i. Dimmer Switches, Incandescent Lamps: NEMA WD 1, solid state modular unit.
 - j. Dimmer Switches, Fluorescent Lamps: Full-wave modular type AC dimmer.
 - k. Telephone Jacks: Modular, flush in face of wall, plated.
 - l. Wall Plates: Single and combination types, steel plate with baked-on finish.
 - m. Floor Service Outlets: Modular, above-floor type floor service outlets and fittings.
 - n. Poke-Through Assembly Devices: Above-floor service and below-floor box.
 - o. Telephone/Power Service Poles: Combination phone and power poles with trim.
 7. Grounding:
 - a. Grounding Equipment: UL 467; copper conductors; wire and cable conductors.
 - b. Grounding Electrodes: Copper-clad steel ground rods; copper plate electrodes.

8. Busways:
 - a. Busways: Feeder type, ANSI/UL 857, NEMA BU 1.
 - b. Busways: Plug-in type, ANSI/UL 857, NEMA BU 1.
 - c. Busways: General purpose plug-in type, ANSI/UL 857, NEMA BU 1.
 - d. Plug-In Devices: Circuit breaker, fusible switch, fuse, combination starter plugs.
9. Fuses:
 - a. Cartridge Fuses: ANSI/IEEE FU 1, nonrenewable cartridge type.
 - b. Spare Fuse Cabinet: Wall-mounted steel unit.
10. Overcurrent Protective Devices:
 - a. Overcurrent Protective Devices: Integral to panelboards and switchboards.
 - b. Cartridge Fuses: NEMA FU 1, class suitable for use.
 - c. Fusible Switches: UL 98, NEMA KS 1.
 - d. Fused Power Circuit Devices: UL 977.
 - e. Molded Case Circuit Breakers: UL 489, NEMA AB 1.
 - f. Insulated Case Circuit Breakers: UL 489, NEMA AB 1.
11. Motor Controllers:
 - a. Manual Motor Controllers: Quick-make, quick-break toggle action.
 - b. Magnetic Motor Controllers: Full-voltage nonreversing, across-the-line type.
 - c. Multispeed Motor Controllers: Full-voltage nonreversing, across-the-line type.
 - d. Reduced-Voltage Motor Controllers: Star-delta magnetic type.
 - e. Reduced-Voltage Motor Controllers: Part winding magnetic type.
 - f. Reduced-Voltage Motor Controllers: Autotransformer magnetic type.
 - g. Reduced-Voltage Motor Controllers: Solid state type.
 - h. Solid-State, Variable-Speed Motor Controllers: NEMA Design B.
 - i. Combination Controller/Disconnect: Suitable for use.
12. Enclosed Controllers, Motor Control Center (MCC) Components:
 - a. MCC Features: Modular motor controllers.
 - b. MCC Wiring Classification: Class I, NEMA ICS 2.
 - c. MCC Wiring Classification: Class II, NEMA ICS 2.
 - d. MCC Enclosure: NEMA Type I.
 - e. Buses: Plated copper, ampacity rating as applicable to main buses.
 - f. Buses: Plated aluminum, ampacity rating as applicable to main buses.

SECTION 26 30 00
Facility Electrical Power Generating and Storing Equipment

PART 1 GENERAL

1.1 SUMMARY

- A. Provide electrical systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.
- C. Comply with the National Electrical Code and applicable local regulations.
- D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.
- E. Provide telephone and data outlets with cutout, box and pull string only.
- F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.
- G. Maintain fire alarm system in operation during construction.
- H. Coordinate with Owner's room uses to provide adequate system for all contract areas.
- I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.
- J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Electrical Systems:
 - 1. Manufacturers: FSR Inc.; Genesis; Leviton Mfg. Co., Inc..
 - 2. Application: Interior lighting.
 - 3. Application: Emergency lighting.
 - 4. Application: Exit signs.
 - 5. Application: Special purpose lighting.
 - 6. Application: Exterior lighting.
 - 7. Application: Photovoltaic collectors.
 - 8. Application: Packaged generator assemblies.
 - 9. Application: Emergency generators.
 - 10. Application: Battery equipment.
 - 11. Application: Lightning protection.
 - 12. Application: Cathodic protection.
 - 13. Application: Modifications to existing electrical system.
 - 14. Sustainable Design: Occupancy sensors.
 - 15. Sustainable Design: Perimeter daylighting controls.
 - 16. Sustainable Design: Energy efficient equipment and fixtures.
 - 17. Sustainable Design: Energy efficient bulbs.
 - 18. Sustainable Design: Energy modeling.
 - 19. Sustainable Design: Commissioning.
 - 20. Type: Instrumentation and control for electrical systems.
 - a. Power monitoring and control.
 - b. Lighting control devices.
 - c. Photoelectric switches.
 - d. Occupancy sensors.
 - e. Central dimming controls.
 - f. Manual dimming controls.
 - g. Network lighting controls.
 - h. Theatrical lighting controls.
 - 21. Type: Wiring devices.
 - a. Receptacles.
 - b. Switches.
 - c. Dimmers.
 - d. Finish plates.
 - e. Door chimes.
 - 22. Type: Facility electrical power generating and storing equipment.
 - a. Photovoltaic collectors.
 - b. Diesel-engine generators.
 - c. Gas engine generators.
 - d. Steam-turbine generators.
 - e. Hydro-turbine generators.
 - f. Wind energy equipment.
 - g. Uninterruptible power units.
 - 23. Type: Lighting.
 - a. Interior lighting fixtures, lamps, and ballasts.
 - b. Emergency lighting.
 - c. Exit signs.
 - d. Hazardous area location lighting.
 - e. Special purpose lighting.
 - f. Underwater lighting.
 - g. Security lighting.
 - h. Display lighting.
 - i. Theatrical lighting.
 - j. Detention lighting.

- k. Healthcare lighting.
- l. Exterior lighting poles and standards.
- m. Parking lighting.
- n. Roadway lighting.
- o. Area lighting.
- p. Landscape lighting.
- q. Site lighting.
- r. Walkway lighting.
- s. Flood lighting.
- t. Exterior athletic lighting.
- 24. Connected Loads: Suitable for service.
 - a. Public area lighting.
 - b. Internal operations lighting.
 - c. Garage lighting.
 - d. Site lighting.
 - e. Convenience power.
 - f. Mechanical cooling.
 - g. Mechanical and plumbing equipment.
 - h. Elevators.
 - i. Emergency generator system.
- 25. IEEE Illumination Levels: Suitable for service.
 - a. Public areas.
 - b. Offices.
 - c. Circulation.
 - d. Kitchen.
 - e. Storage.
 - f. Mechanical.
 - g. Garage.
 - h. Parking lots.
- 26. Components: Suitable for service.
 - a. Cables, conduit, and tubing.
 - b. Grounding and bonding devices.
 - c. Hangers and supports.
 - d. Raceways, boxes, and cabinets.
 - e. Cable trays.
 - f. Vibration and seismic controls.
 - g. Identification devices and warning labels.
 - h. Service entrance components.
 - i. Switchboards.
 - j. Low-voltage power switchgear.
 - k. Grounding components.
 - l. Transformers.
 - m. Motor controllers.
 - n. Busways.
 - o. Overcurrent protective devices.
 - p. Panelboards.
 - q. Fuses.
- 27. Electrical Standards.
 - a. Code: NFPA 70 National Electrical Code.
 - b. Fluorescent Fixtures: Fixtures, UL 1570; ballasts, UL 935, energy-saving.
 - c. HID Fixtures: UL 1572; ballasts, UL 1029; instant restrike device.
 - d. Incandescent Fixtures: UL 1571.
 - e. Fixtures for Hazardous Locations: UL 844.
 - f. Track Lighting Systems: UL 1574.
 - g. Exit Signs: UL 924.
 - h. Emergency Lighting Units: UL 924.

- i. Emergency Fluorescent Power Supply: UL 924.
- j. Lamps: ANSI Standards, C78 series.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.
- E. Install thermostats centered above light switches at 60" above finished floor.
- F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.
- G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.
- H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.
- I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.
- J. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 32 00
PACKAGED GENERATOR ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Provide packaged generator assemblies.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compliance: NFPA 110.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Packaged Generator Assemblies:
 - 1. Manufacturers: Refer to www.arcata.com/divs/sec/sec16230.html
 - 2. Application: Locations indicated.
 - 3. Sustainable Design: Utility efficient equipment and fixtures.
 - 4. Sustainable Design: Commissioning.
 - 5. Packaged Engine Generator System Components:
 - a. Engine: NFPA 37.
 - b. Engine Fuel: Diesel fuel oil grade DF-2.
 - c. Cooling System: Closed-loop, liquid-cooled, radiator mounted.
 - d. Fuel Supply System: NFPA 30, 37; day tank, piping and storage tank.
 - e. Engine Exhaust System: Muffler type suitable for use.
 - f. Combustion Air-Intake System: Filter type air intake silencer, intake duct
 - g. Starting System: Electric with negative ground.
 - h. Control and Monitoring: Operating and safety indications, engine gages.
 - i. Generator, Exciter, and Voltage Regulator: NEMA MG 1, direct drive.
 - j. Load Bank: Permanent outdoor, remotely controlled, forced-air cooled.
 - k. Outdoor Generator Set Enclosure: Weatherproof steel housing, louvers.
 - l. Transfer Switches: Automatic.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved

submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- C. Clearly label and tag all components.
- D. Test and balance all systems for proper operation.
- E. Restore damaged finishes. Clean and protect work from damage.
- F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Provide interior lighting.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compliance: NFPA 70 "National Electrical Code."

PART 2 PRODUCTS

2.1 MATERIALS

- A. Interior Lighting:
 - 1. Manufacturers: ENCELIUM; Legrand; Wattstopper; Wenger Corporation, JR Clancy and GearBoss.
 - 2. Application: Locations indicated.
 - 3. Sustainable Design: Utility efficient equipment and fixtures.
 - 4. Sustainable Design: Commissioning.
 - 5. Components: Suitable for service.
 - a. Fluorescent Fixtures: UL 1570; ballasts, UL 935, energy saving.
 - b. High Intensity Discharge (HID) Fixtures: UL 1572; ballasts, UL 1029.
 - c. Incandescent Fixtures: UL 1571.
 - d. LED Fixtures: UL 844.
 - e. LED Light Source: UL 8750.
 - f. Fixtures for Hazardous Locations: UL 844.
 - g. Track Lighting Systems: UL 1574.
 - h. Exit Signs: UL 924, self-powered battery type and luminous source type.
 - i. Emergency Lighting Units: UL 924.
 - j. Emergency Fluorescent Power Supply: UL 924.
 - k. Lamps: ANSI Standards, C78 series.
 - l. Suspended Fixture Support Components: Stem, rod, and hook hangers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- C. Test all systems for proper operation. Label circuits in electrical panels.
- D. Restore damaged finishes. Clean and protect work from damage.
- E. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Provide exterior lighting.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compliance: NFPA 70 "National Electrical Code."

PART 2 PRODUCTS

2.1 MATERIALS

- A. Exterior Lighting:
 - 1. Manufacturers: ENCELIUM; FEC Heliports; Wenger Corporation, JR Clancy and GearBoss.
 - 2. Application: Area and site lighting.
 - 3. Application: Parking garage lighting.
 - 4. Application: Wall mount lighting.
 - 5. Application: Architectural floodlighting.
 - 6. Application: Industrial floodlighting.
 - 7. Application: Accent and pathway lighting.
 - 8. Application: Locations indicated.
 - 9. Sustainable Design: Utility efficient equipment and fixtures.
 - 10. Sustainable Design: Commissioning.
 - 11. Exterior Lighting Components:
 - a. Fluorescent Fixtures: UL 1570; ballasts, UL 935, energy-saving.
 - b. High Intensity Discharge (HID) Fixtures: UL 1572; ballasts, UL 1029.
 - c. Incandescent Fixtures: UL 1571.
 - d. LED Fixtures: UL 844.
 - e. LED Light Source: UL 8750.
 - f. Lamps: ANSI Standards, C78 series.
 - 12. Fixture Support Poles, Mast Arms and Brackets:
 - a. Steel tubing.
 - b. Aluminum.
 - c. Fiberglass.
 - d. Laminated wood.

- e. Pressure-treated wood.
- f. Prestressed concrete.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Clearly label and tag all components.
- C. Test and balance all systems for proper operation.
- D. Restore damaged finishes. Clean and protect work from damage.
- E. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 05 00
COMMUNICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide communications systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compliance: FCC regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Communications:
 - 1. Manufacturers: Hillrom.
 - 2. Application: Communications equipment room fittings.
 - 3. Application: Communications cabling.
 - 4. Application: Data communications.
 - 5. Application: Voice communications for telephones, fax, modems and messaging.
 - 6. Application: Audio-video systems.
 - 7. Application: Communications and monitoring systems.
 - 8. Application: Modifications to existing communications systems.
 - 9. Sustainable Design: Energy efficient equipment and fixtures.
 - 10. Sustainable Design: Commissioning.
 - 11. Type: Communications cabling.
 - a. Copper cabling.
 - b. Optical fiber cabling.
 - c. Coaxial cabling.
 - d. Dial tone cabling.
 - e. T1 services cabling.
 - f. DSL services cabling.
 - g. Cable services cabling.
 - h. Satellite cabling.
 - 12. Type: Data communications equipment.
 - a. Firewalls.
 - b. Routers.
 - c. Network management.

- d. Wireless access points.
- 13. Type: Voice communications.
 - a. Telephone sets.
 - b. Wireless transceivers.
 - c. Elevators telephones.
 - d. Ring-down emergency telephones.
 - e. Facsimiles and modems.
 - f. TTY equipment.
- 14. Type: Audio-video communications.
 - a. Restaurant and bar systems.
 - b. Conference room systems.
 - c. Board room systems.
 - d. Classroom systems.
 - e. Theater systems.
 - f. Auditorium systems.
 - g. Stadium and arena systems.
- 15. Type: Digital signage systems.
 - a. Point of sale systems.
 - b. Transportation information display systems.
 - c. Public information systems.
- 16. Type: Communications and monitoring systems.
 - a. Paging systems.
 - b. Public address and mass notification systems.
 - c. Sound masking systems.
 - d. Intercommunication systems.
 - e. Patient monitoring and telemetry systems.
 - f. Healthcare imaging systems.
 - g. Nurse call/code blue systems.
 - h. Clock systems.
 - i. Internal cellular, paging, and antenna systems.
- 17. Components: Suitable for service.
 - a. Communications services.
 - b. Cables, conduit, and tubing.
 - c. Grounding and bonding devices.
 - d. Hangers and supports.
 - e. Surface raceways, boxes, and cabinets.
 - f. Underground ducts and raceways.
 - g. Utility poles.
 - h. Cable trays.
 - i. Vibration and seismic controls.
 - j. Identification devices and warning labels.
 - k. Transformers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- C. Clearly label and tag all components.

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- C. Clearly label and tag all components.
- D. Test and balance all systems for proper operation.
- E. Restore damaged finishes. Clean and protect work from damage.
- F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 41 00
AUDIO-VIDEO SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide audio-video systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Audio-Video Systems:
1. Manufacturers: Wenger Corporation, JR Clancy and GearBoss.
 2. Application: Locations indicated.
 3. Sustainable Design: Utility efficient equipment and fixtures.
 4. Sustainable Design: Commissioning.
 5. CCTV System Components:
 - a. Cameras: CCD imaging type.
 - b. Lenses: Fixed lenses; motorized remote controlled zoom lenses.
 - c. Camera Supporting Equipment: Minimum safety factor of 2.0.
 - d. Pan Units: Motorized automatic scanning units.
 - e. Pan and Tilt Units: Motorized units for remote-controlled aiming of cameras.
 - f. Accessories: Mounting brackets, steel dustproof housings for fixed cameras.
 - g. Monitors: Monochrome, metal cabinet units designed for continuous operation.
 - h. Visual Tape Recorder: Industrial time lapse type for continuous operation.
 - i. Manual Switch Bank: Low-loss, high-isolation multiple video switches.
 - j. Sequential Switchers: Automatically sequence outputs of multiple cameras.
 - k. Pan, Tilt, and Zoom Controls: Arranged for multiple-camera control.
 - l. CCTV Master Control Station: Modular metal furniture with wiring.
 - m. CCTV Coaxial Cable Connectors: Type BNC, 75 ohms.
 6. MATV System Components:
 - a. Antennas: Weatherproof broadband log-periodic type.
 - b. FM Antenna: Omnidirectional type.
 - c. Antenna-Supporting Structures: EIA 222-D, FCC Part 17.
 - d. Preamplifiers: Coaxial download broadband or single channel type.
 - e. Headend Equipment: Processors, broadband and single channel amplifiers.

- f. Processors for UHF to VHF Translation: 6 MHz bandwidth.
- g. Amplifiers: Broadband, single channel and distribution power amplifiers.
- h. Power Supplies: NRTL listed, regulated, modular units.
- i. Line Taps: Signal power splitters and isolation taps.
- j. Signal Traps: Packaged filters tuned to interference frequencies.
- k. Attenuators: Adjustable to eliminate overload.
- l. Terminating Resistors: Enclosed units rated 1/2 watts.
- m. Outlets: Flush type, wall plates with female type connectors.
- n. MATV Coaxial Cable Connectors: Type F, 75 ohms.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- C. Clearly label and tag all components.
- D. Test and balance all systems for proper operation.
- E. Restore damaged finishes. Clean and protect work from damage.
- F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 51 16
PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide public address and mass notification systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Public Address and Mass Notification Systems:
1. Manufacturers: LogiSon Acoustic Network.
 2. Application: Locations indicated.
 3. Sustainable Design: Utility efficient equipment and fixtures.
 4. Sustainable Design: Commissioning.
 5. Public Address System Components:
 - a. Equipment: Solid state, rated for continuous duty.
 - b. Preamplifiers: Sized for anticipated service.
 - c. Power Amplifiers: Rack mounted.
 - d. Power Amplifier Monitoring: Automatic transfer to standby amplifier.
 - e. Microphones: Dynamic type, with cardioid polar or unidirectional characteristic.
 - f. Volume Limiter/Compressor: For each zone, maximum one percent distortion.
 - g. Control Console: Switches/pushbuttons controls, visual annunciation indicator.
 - h. Telephone Paging Adapter: Paging adapter for all zones.
 - i. Clock and Program System Adapter: Interface with central clock and program.
 - j. Equipment Cabinet: Steel cabinet with locking doors and rack, ventilation fan.
 - k. Equipment Rack: EIA standards.
 - l. Power Control Panel: Master switch and pilot light, cartridge fuse socket, light.
 - m. Monitor Panel: Volume unit or meter, speaker with volume control, switch.
 - n. Cone Type Loudspeakers: 45 decibels axial sensitivity.
 - o. Horn Type Loudspeakers: Single or double horn units with single driver.
 - p. Noise-Operated Gain Controller: Level adjustment range, 20 dB minimum.
 - q. Volume Attenuator Stations: For groups of speakers.
 - r. Microphone Outlets: Three pole, polarized, locking type, female receptacles.
 - s. Battery Backup Power Unit: Minimum one-hour capacity.

- t. Wire and Cable: Speaker circuit conductors.
- u. Weatherproof Equipment: For exterior or wet locations.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- C. Clearly label and tag all components.
- D. Test and balance all systems for proper operation.
- E. Restore damaged finishes. Clean and protect work from damage.
- F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 51 19
SOUND MASKING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide sound masking systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sound Masking Systems:
 - 1. Manufacturers: LogiSon Acoustic Network.
 - 2. Application: Locations indicated.
 - 3. Sustainable Design: Utility efficient equipment and fixtures.
 - 4. Sustainable Design: Commissioning.
 - 5. Sound Masking System Components:
 - a. Components: Modular plug-in type, industrial grade integrated circuit devices.
 - b. Noise Generator and Filter Units: Pink noise generator output.
 - c. Programmable Audio Level Control Unit: Nonvolatile program memory.
 - d. Power Amplifiers: UL 1711, 6 RMS power rating.
 - e. Masking Speaker Assemblies: UL 1480 speakers with matching transformers.
 - f. Speaker Wire: Untinned, twisted pair, solid copper wire with PVC jacket.
 - g. Component Mounting Racks: Relay racks with steel cabinet with locks.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.
- B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

- C. Clearly label and tag all components.
- D. Test and balance all systems for proper operation.
- E. Restore damaged finishes. Clean and protect work from damage.
- F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 28 05 00
ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 SUMMARY

- A. Provide electronic safety and security systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compliance: UL 609, 681, 1023, 1076, 1641, FM approval as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Electronic Safety and Security Systems:
1. Application: Access control and intrusion detection.
 2. Application: Video surveillance.
 3. Application: Personal alarm annunciation systems.
 4. Application: Fire detection and alarm.
 5. Application: Radiation detection and alarm.
 6. Application: Fuel-gas detection and alarm.
 7. Application: Fuel-oil detection and alarm.
 8. Application: Refrigerant detection and alarm.
 9. Application: Electronic detention monitoring and control.
 10. Application: Modifications to existing electronic safety and security systems.
 11. Type: Access control.
 - a. Access door control.
 - b. Intrusion detection.
 - c. Video surveillance.
 - d. Metal detectors.
 - e. X-ray equipment.
 - f. Sniffing equipment.
 - g. Explosive detection equipment.
 - h. Burglary systems.
 - i. Perimeter security systems.
 12. Type: Electronic surveillance.

- a. Video surveillance.
- b. Alarm annunciation systems.
- c. Emergency aid devices.
- 13. Type: Electronic detection and alarm.
 - a. Fire detection sensors.
 - b. Smoke detection sensors.
 - c. Carbon-monoxide sensors.
 - d. Fire alarm pull stations.
 - e. Fire alarm horns and strobes.
 - f. Radiation detection and alarm systems.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Provide core drilling as required for new work.
- D. Conceal conduit to the greatest extent practical.
- E. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- F. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- G. Test all systems for proper operation. Label circuits in electrical panels.
- H. Restore damaged finishes. Clean and protect work from damage.
- I. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 28 13 53
INTRUSION DETECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Provide intrusion detection system including sensors, signal equipment, controls, and alarm displays.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
 - 1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compliance: UL 609, 681, 1023, 1076, 1641, FM approval as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Intrusion Detection Systems:
 - 1. Manufacturers: Digital Watchdog®; Eagle Eye Networks; Honeywell Commercial Security.
 - 2. Application: Locations indicated.
 - 3. Sustainable Design: Utility efficient equipment and fixtures.
 - 4. Sustainable Design: Commissioning.
 - 5. System Component Requirements:
 - a. Surge protection.
 - b. Interference protection.
 - c. Tamper protection.
 - d. Self-Testing devices.
 - e. Antimasking devices.
 - f. Addressable devices.
 - g. Remote-Controlled devices.
 - 6. Secure And Access Devices:
 - a. Keypad and display module.
 - b. Key-operated switch.
 - 7. Intrusion Detection System Components:
 - a. Surge Protection: UL 1449.
 - b. Interference Resistance: Not affected by radio frequency and electrical.
 - c. Tamper Protection: Tamper protection switches.

- d. Intrusion Detection Devices: Types and mounting conditions as applicable.
- e. Alarm Contact Arrangement: Single-pole, double-throw type.
- f. Door and Window Switches: UL 634.
- g. Space Intrusion Detection Devices: UL 639, devices as applicable.
- h. System Control Panel: UL compliance for type of unit.
- i. Duress alarm switches.
- j. Secure-Access Control Stations: Keypad, display module, key-operated switch.
- k. System Printer: Suitable for service with NRTL label.
- l. Wire and Cable: Stranded copper.
- 8. Central-Station Control Units
 - a. Annunciator.
 - b. Central-station control-unit hardware.
 - c. Central-station control-unit software.
 - d. Audible and visual alarm devices.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Provide core drilling as required for new work.
- D. Conceal conduit to the greatest extent practical.
- E. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- F. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- G. Test all systems for proper operation. Label circuits in electrical panels.
- H. Restore damaged finishes. Clean and protect work from damage.
- I. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SUMMARY

- A. Provide fire detection and alarm systems.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.
- C. Warranty: Submit manufacturer's standard warranty. Include labor and materials to repair or replace defective materials.
- D. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Compliance: NFPA 70, 71, 72, 72E, 72G, 72H.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fire Detection and Alarm Systems:
1. Manufacturers: [Aerionics Inc dba Macurco Gas Detection](#); [Brasch Environmental Technologies](#).
 2. Application: Locations indicated.
 3. Sustainable Design: Utility efficient equipment and fixtures.
 4. Sustainable Design: Commissioning.
 5. Signal Transmission: Hard-wired individual circuits.
 6. Audible Alarm Indication: Horns, bells, and voice alarm messages.
 7. Interface: Smoke removal systems, smoke dampers, air handling units control.
 8. Components: Suitable for service.
 - a. Manual Pull Stations: Double-action type, metal or plastic.
 - b. Smoke Detectors: UL 268, self-restoring type with visual indicator.
 - c. Thermal Detectors: Fixed-temperature and rate-of-rise type.
 - d. Flame Detectors: Ultraviolet type with delay.
 - e. Fire Alarm Bells: Electric vibrating under-dome type.
 - f. Fire Alarm Horns: Electric vibrating polarized type.
 - g. Visual Alarm Devices: Dual-voltage strobe lights.
 - h. Voice/Tone Speakers: UL 1480 type.
 - i. Fire Fighters Telephones: Handset with supervised communication lines.

- j. Device Location-Indicating Lights: System-voltage-indicating light.
- k. Magnetic Door Holders: Wall or floor mounted type.
- l. Fire Alarm Control Panel: UL 864.
- m. Graphic Annunciator: LED indicators on graphic building floor plan.
- n. Transmitter: Auto-dialer type.
- o. Emergency Power Supply: Battery operated, 24-hour operation capacity.
- p. Line-Voltage and Low-Voltage Circuits: Solid copper conductors, color-coded.
- q. Conduit: Rigid steel, hardened, fire-rated.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.
- B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.
- C. Provide core drilling as required for new work.
- D. Conceal conduit to the greatest extent practical.
- E. Center ceiling-mounted elements in center of ceiling tiles as applicable.
- F. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.
- G. Test all systems for proper operation. Label circuits in electrical panels.
- H. Restore damaged finishes. Clean and protect work from damage.
- I. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 33 50 00
FUEL DISTRIBUTION UTILITIES

PART 1 GENERAL

1.1 SUMMARY

- A. Provide piped energy distribution system piping, specialties, and accessories outside the building.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI Z223.1 or NFPA 54 or AGA IFGC and local codes for materials, installation, testing, inspection, and purging.
- B. Minimum Working-Pressure Ratings:
 - 1. Piping and Valves: 100 psig.
 - 2. Service Regulators: 100 psig.
 - 3. Service Meters: 20 psig.
 - 4. Aboveground Fuel Oil Piping: 150 psig.
 - 5. Underground Fuel Oil Piping: 150 psig.
 - 6. Vent, Gauge, and Fill Piping: 100 psig.
 - 7. Fuel Oil Storage Tanks: 5 psig.
 - 8. Fuel Oil Storage Tank, Outer Containment Shell Walls: 5 psig.
 - 9. Containment Conduit Piping System, Carrier Pipe: 150 psig.
 - 10. Containment Conduit Piping System, Containment Conduit: 5 psig.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Oil Storage Tanks:
 - 1. Manufacturers: Refer to www.arcat.com/divs/sec/sec02550.html
 - 2. Aboveground Types:
 - a. Steel tanks Steel Tank Institute (STI) standards and UL 142; horizontal or vertical; double-wall.
 - b. Containment-dike, single wall steel:
 - c. Thermally insulated tanks complying with STI F941 and UL 2085.
 - 3. Below Ground Types:
 - a. Steel tanks complying with STI- P3 and UL 58.
 - b. Composite tanks complying with STI F894 and UL 58.
 - c. Jacketed tanks complying with STI F922 and UL 58.
 - d. Glass-fiber-reinforced-plastic (FRP) tanks complying with UL 1316.
 - 4. Tank Fittings and Accessories: Tank manholes, ladders, supply tube, tank supports.
 - 5. Submersible turbine or multistage centrifugal fuel oil pump for flammable liquids.
 - 6. Tank Specialties: Precast concrete manholes with cast-iron frame and cover, liquid-level gauge systems.
 - 7. Gage System: Calibrated, liquid-level gage system.

8. Monitoring System: Calibrated, leak-detection and -monitoring system.
9. Fuel Oil: Grade as available.
10. Piping and Specialties: Suitable for service

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with local utility company requirements, pipe manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
- B. Test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 33 70 00
ELECTRICAL AND COMMUNICATIONS UTILITIES

PART 1 GENERAL

1.1 SUMMARY

- A. Provide underground conduits and ducts, duct banks, pull boxes and handholes, manholes, and other underground utility structures.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
- B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.
- B. Devices, and Accessories Including Ducts for Communications and Telephone Service: Listed and labeled as defined in NFPA 70, Article 100.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Underground Electrical and Communications Utilities:
 - 1. Manufacturers: **TerraTape, Div. of Reef Industries, Inc.**
 - 2. Application: Utility structures for building electrical and communications utilities.
 - 3. Electrical Utility Service: Plastic utilities duct encased in concrete.
 - 4. Electrical Feeders: Direct buried rigid plastic conduit.
 - 5. Electrical Branch Circuits: Flexible corrugated conduit encased in concrete.
 - 6. Telephone Utility Service: Plastic utilities duct encased in concrete.
 - 7. Communication Circuits: Plastic underground conduit encased in concrete.
 - 8. Conduit and Duct: Rigid steel and rigid nonmetallic conduit.
 - 9. Pull Boxes and Handholes: Suitable for service.
 - 10. Precast Concrete Utility Structures: Interlocking precast units.
 - 11. Accessories:
 - a. Duct Supports: Rigid PVC.
 - b. Frames and Covers: Cast iron with cast-in legend.
 - c. Sump Frame and Grate: FS RR-F-621, Type VII for frame and Type I for cover.
 - d. Components: Pulling eyes in walls, pulling and lifting irons in floor, cable stanchions, arms and cable support insulators, ladder.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections.

- B. Test all systems for proper operation.
- C. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION