

TABLE OF CONTENTS

(95% Specifications)

INTRODUCTORY INFORMATION

Section A	Request for Proposal
Section B	Proposal Form & Summary of Work
Section C	List of Drawings
Section D	Sample A-132 Form of Agreement between Owner & Contractor
Section E	Sample A-232 General Conditions of the Contract for Construction

GENERAL REQUIREMENTS

01 0100	Summary of Work
01 0200	Allowances
01 0300	Alternates
01 0400	Project Schedule
01 0500	Submittal Procedures
01 0600	Substitution Request Form
01 0700	Mock-Ups
01 0800	Closeout Procedures
01 0900	Operations, Maintenance Data and Warranties

CIVIL

01 0050	General Requirements
01 0100	Summary of Work
02 1000	Site Preparation
02 2200	Earthwork
02 5140	Portland Cement Concrete Paving
02 5290	Concrete Sidewalk
02 6120	Concrete Pipe
02 9300	Seeding, Sodding, Sprigging and Mulching
03 1080	Formwork
03 2080	Concrete Reinforcement
03 3110	Concrete Mixing, Placing, Jointing and Curing
03 3480	Concrete Finishing and Repair of Surface Defects
03 3500	Testing
15 0640	Polyvinyl Chloride (PVC) Pipe & Fittings
15 1000	Valves and Appurtenances

ARCHITECTURAL

06 4020	Interior Architectural Woodwork
07 2100	Building Insulation
07 9200	Joint Sealants

STRUCTURAL

05 5000	Metal Fabrications
---------	--------------------

Bulk Warehouse

01 4100	Structural Tests and Special Inspections
03 3000	Cast-In-Place Concrete
06 1000	Rough Carpentry
06 1323	Heavy Timber Framing
06 1600	Sheathing
06 1753	Shop-Fabricated Wood Trusses
06 1800	Glued-Laminated Construction

Office Building

01 4100	Structural Tests and Special Inspections
03 3000	Cast-In-Place Concrete

Warehouse

01 4100	Structural Tests and Special Inspections
03 3000	Cast-In-Place Concrete
13 3419	Pre-engineered Metal Building

Mechanical

15010	General Provisions
15020	Basic Mechanical Requirements
15050	Pipe & Fittings
15060	Valves
15080	Mechanical Supporting Devices
15160	Mechanical System Insulation
15260	Fire Protection System
15300	Plumbing Fixtures, Trim and Accessories
15760	Exhaust Fans
15820	Packaged A/C and Heating Equipment
15860	Ductworks and Accessories
15940	Testing and Balancing
15960	Project Closeout

ELECTRICAL

16 0100	General Requirements
16 0200	Codes and Standards
16 0300	Electrical Systems Schedule
16 0400	Basic Material and Methods
16 1110	Conduit and Fittings
16 1200	Wire and Cable
16 1300	Boxes
16 1400	Wiring Devices
16 1600	Cabinets and Enclosures
16 1700	Grounding and Bonding Systems
16 1800	Equipment Wiring Systems
16 1900	Supporting Devices
16 1950	Electrical Identification
16 2800	Surge Protective Devices (SPDs)
16 4610	Dry Type Transformers

16 4700	Lighting and Power Panel Boards
16 4820	Magnetic Motor Starters
16 5010	Lamps
16 5100	Interior and Exterior Lighting System
16 5350	Self-Contained Emergency Lighting Systems
16 6000	Underground System
16 7410	Telephone Service System (Rough-In)

SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Laminate-clad cabinets (plastic-covered casework).
 - 2. Plastic-laminate countertops.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- C. Samples for initial selection of the following in the form of manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Plastic laminates.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
- B. Single-Source Responsibility for Fabrication and Installation: Engage a qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.
- C. Quality Standard: Except as otherwise indicated, comply with the following standard:
 - 1. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grades of interior architectural woodwork, construction, finishes, and other requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the following products are part of interior woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:
- B. General: Provide materials that comply with requirements of the WIC quality standard for each type of woodwork and quality grade indicated, unless otherwise indicated.
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2.
 - 3. Particleboard: ANSI A208.1, Grade M-2.
- C. Fiberboard: Medium-density fiberboard made without formaldehyde and complying with ANSI A208.2.
- D. Particleboard: ANSI A208.1, Grade M-2 made with phenol-formaldehyde resins.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated in the Work include, but are not limited to, the following:
 - a. Formica Corporation.

- b. Laminart.
- c. Nevamar Corp.
- d. Pioneer Plastics Corp.
- e. Westinghouse Electric Corp.; Specialty Products Div.
- f. Ralph Wilson Plastics Co.

2.2 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide interior woodwork complying with the referenced quality standard and of the following grade:
 - 1. Grade: Custom.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.
- C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

2.3 LAMINATE-CLAD CABINETS (PLASTIC-COVERED CASEWORK)

- A. Quality Standard: Comply with AWI Section 400 requirements for laminate-clad cabinets.
- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other than Tops: GP-50, 0.050-inch (1.270-mm) nominal thickness.
 - 2. Postformed Surfaces: PF-42, 0.042-inch (1.067-mm) nominal thickness.
 - 3. Vertical Surfaces: GP-50, 0.050-inch (1.270-mm) nominal thickness.
 - 4. Edges: GP-50, 0.050-inch (1.270-mm) nominal thickness.
- D. Materials for Semiexposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other than Drawer Bodies: High-pressure decorative laminate, Grade GP-28.
 - 2. Drawer Sides and Backs: Thermoset decorative overlay.
 - 3. Drawer Bottoms: Thermoset decorative overlay.
- E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. Provide Architect's selections from laminate manufacturer's full range of colors and finishes in the following categories:

- a. Solid colors.

2.4 COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
- B. Type of Top: High-pressure decorative laminate complying with the following:
 - 1. Grade: GP-50, 0.050-inch (1.270-mm) nominal thickness.
 - 2. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. Provide Architect's selections from manufacturer's full range of colors and finishes in the following categories:
 - 1) Solid colors.
 - 3. Edge Treatment: Rolled Edge.
 - 4. Core Material: Medium-density particleboard.
 - 5. WIC Section 17E, "Decorative Synthetic Marble Countertops and Sinks."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.

3.2 INSTALLATION

- A. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm)
- B. Anchor woodwork to anchors or blocking built in or directly attached to substrates.
- C. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
- D. Tops: Anchor securely to base units and other support systems as indicated. Calk space between backsplash and wall with specified sealant.
 - 1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.

3.4 Clean woodwork on exposed and semiexposed surfaces.

3.5 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.

3.6 CABINET HARDWARE AND ACCESSORY SCHEDULE

- A. Concealed (European Type) Hinges: B01602.
- B. Pulls: Wire pulls, 4 inches (100 mm) long, 5/16 inches (8 mm) in diameter.
- C. Catches: As follows:
 - 1. Magnetic Catches: B03141.
- D. Adjustable Shelf Standards: B04071.
 - 1. Shelf Rests for Standards: B04081.
- E. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, complying with BHMA A156.9, Grade 1 and rated for the following loads:
 - 1. Box Drawer Slides: 75 lbf (330 N).
 - 2. File Drawer Slides: 150 lbf (670 N).
 - 3. Pencil Drawer Slides: 45 lbf (200 N).
- F. Grommets for cable passage through countertops: 1 inch (25 mm) OD, molded-plastic grommets with 3/4-inch (19-mm) hole and plastic cap with slot for wire passage.

END OF SECTION 06402

SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Concealed building insulation.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:
 - 1. Glass-Fiber Insulation:
 - a. CertainTeed Corporation.
 - b. Knauf Fiber Glass GmbH.
 - c. Owens-Corning Fiberglas Corporation.
 - d. Schuller International, Inc.

2.2 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
 - 1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.
- B. Unfaced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).
 - 1. Mineral-Fiber Type: Fibers manufactured from glass.
- C. Faced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type III, Class A (membrane faced surface with a flame spread index of 25 or less); with kraft vapor-retarder membrane on 1 face.
 - 1. Mineral-Fiber Type: Fibers manufactured from glass.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply single layer of insulation to produce thickness indicated.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

- B. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
- C. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
 - 1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
 - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3.5 PROTECTION

- A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210

SECTION 07920 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes sealants for the following applications:
 - 1. Exterior joints in the following vertical and horizontal surfaces:
 - b. Control and expansion joints in unit masonry.
 - e. Perimeter joints between materials listed above and frames of doors and windows.
 - h. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain joint sealant through one source from a single manufacturer.
- D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates as follows:
 - 1. Locate test joints as directed by Architect.
 - 2. Test Method: Test joint sealants by hand-pull method described below:

- a. Install joint sealants in 60-inch- (1500-mm-) long joints using same materials and methods for joint preparation and joint-sealant installation required for the completed Work. Allow sealants to cure fully before testing.
 - b. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches (50 mm) long at sides of joint and meeting cross cut at one end. Place a mark 1 inch (25 mm) from cross-cut end of 2-inch (50-mm) piece.
 - c. Use fingers to grasp 2-inch (50-mm) piece of sealant between cross-cut end and 1-inch (25-mm) mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
 - d. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.
3. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 4. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with sealant manufacturer's recommended minimum and maximum installation temperatures and other weather protection.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within two (2) years from date of Substantial Completion.
 1. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with

performance and other requirements specified in this Section within 10 years from date of Substantial Completion.

- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. SILICONE SEALANT
 - 1. Single component elastomeric silicone sealant; FS TT-S-001543, Class A, nonsag; ASTM C 920, Type S, Grade NS, Class 25
 - 2. Color: As selected by Architect
 - 3. Acceptable Products:
 - a. Dow Corning 795
 - b. G.E. Silpruf
- B. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners: Non-corrosive, non-staining type acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent surfaces in any way,.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- D. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants by hand-pull method described in QUALITY ASSURANCE section above.
 - 3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

4. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

- B. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealants adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 07920

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 steel doors and frames.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 8 Section "Flush Wood Doors" for hollow-core and solid-core wood doors installed in steel frames.
 - 2. Division 8 Section "Door Hardware" for door hardware and weatherstripping.
 - 3. Division 8 Section "Glazing" for glass in steel doors and sidelights.
 - 4. Division 9 Section "Gypsum Board Assemblies" for spot grouting frames in gypsum board partitions.
 - 5. Division 9 Section "Painting" for field painting primed doors and frames.

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 door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.
- C. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
- D. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings.
 - 1. Indicate coordination of glazing frames and stops with glass and glazing requirements.
- E. Samples for initial selection in the form of manufacturer's color charts showing the full range of colors available for factory-finished doors and frames.
- F. Samples for verification of each type of exposed finish required, prepared on Samples not less than 3 by 5 inches (75 by 125 mm) and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.
- G. Oversize Construction Certification: For door assemblies required to be fire rated and exceeding limitations of labeled assemblies, submit certification of a testing agency acceptable to authorities having jurisdiction that each door and frame assembly has been constructed to conform to design, materials, and construction equivalent to requirements for labeled construction.

1.4 QUALITY ASSURANCE

- A. Provide doors and frames complying with ANSI/SDI 100 "Recommended Specifications for Standard Steel Doors and Frames" and as specified.
- B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per ASTM E 152, and are labeled and listed by UL, Warnock

Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors conform to all standard construction requirements of tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F (250 deg C) maximum in 30 minutes of fire exposure.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- (100-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) spaces between stacked doors to promote air circulation.

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. Steel Doors and Frames:
 - a. Pioneer Industries
 - b. Premier Products
 - c. Windsor Republic

2.2 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial-quality carbon steel, pickled and oiled, complying with ASTM A 569 (ASTM A 569M).
- B. Cold-Rolled Steel Sheets: Carbon steel complying with ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality, special killed.
- C. Galvanized Steel Sheets: Zinc-coated carbon steel complying with ASTM A 526 (ASTM A 526M), commercial quality, or ASTM A 642 (ASTM A 642M), drawing quality, hot-dip galvanized according to ASTM A 525, with A 60 or G 60 (ASTM A 525M, with Z 180 or ZF 180) coating designation, mill phosphatized.
- D. Supports and Anchors: Fabricated from not less than 0.0478-inch- (1.2-mm-) thick steel sheet; 0.0516-inch- (1.3-mm-) thick galvanized steel where used with galvanized steel frames.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize complying with ASTM A 153, Class C or D as applicable.

2.3 DOORS

- A. Steel Doors: Provide 1-3/4-inch- (44-mm-) thick doors of materials and ANSI/SDI 100 grades and models

specified below, or as indicated on Drawings or schedules:

1. Interior Doors: Grade II, heavy-duty, Model 2, seamless design, minimum 0.0478-inch- (1.2-mm-) thick cold-rolled steel sheet faces.
 2. Exterior Doors: Grade II, heavy-duty, Model 2, seamless design, minimum 0.0516-inch- (1.3-mm-) thick galvanized steel sheet faces.
- B. Door Louvers: Provide louvers according to SDI 111C for interior doors where indicated, with blades or baffles formed of 0.0239-inch- (0.6-mm-) thick cold-rolled steel sheet set into minimum 0.0359-inch- (0.9-mm-) thick steel frame.
1. Sight-Proof Louvers: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.

3.4 FRAMES

- A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, according to ANSI/SDI 100, and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated. Fabricate frames as follows:
1. Fabricate frames with mitered or coped and face welded corners.
 2. Fabricate frames for interior and exterior openings of 16 Gage steel sheet.
- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.
- C. Plaster Guards: Provide minimum 0.0179-inch- (0.45-mm-) thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

3.5 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance, and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI/SDI 100 requirements.
1. Internal Construction: One of the following manufacturer's standard core materials according to SDI standards:
 - a. Unitized steel grid.
 - b. Vertical steel stiffeners.
 - c. Rigid mineral fiber with internal sound deadener on inside of face sheets.
 2. Clearances: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 1/4 inch (6.4 mm) between non-fire-rated pairs of doors. Not more than 3/4 inch (19 mm) at bottom.
 - a. Fire Doors: Provide clearances according to NFPA 80.
- B. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel sheet.
- C. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
- D. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- E. Galvanized Steel Doors, Panels, and Frames: For the following locations, fabricate doors, panels, and frames from galvanized steel sheet according to SDI 112. Close top and bottom edges of doors flush as an integral part of door construction or by addition of minimum 0.0635-inch- (1.6-mm-) thick galvanized steel channels, with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration.

1. At exterior locations.
 2. At exterior locations and where indicated.
- F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- G. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.
1. Unless otherwise indicated, provide thermal-rated assemblies with U-value rating of 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) or better.
- H. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.
1. For concealed overhead door closers, provide space, cutouts, reinforcing, and provisions for fastening in top rail of doors or head of frames, as applicable.
- I. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
- J. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- K. Glazing Stops: Minimum 0.0359-inch- (0.9-mm-) thick steel or 0.040-inch- (1-mm-) thick aluminum.
1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
 2. Provide screw-applied, removable, glazing beads on inside of glass, louvers, and other panels in doors.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations relative to applying and designating finishes.
- B. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for steel sheet finishes.
- C. Apply primers and organic finishes to doors and frames after fabrication.

2.7 GALVANIZED STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so that surfaces are free of oil or other contaminants. After cleaning, apply a conversion coating of the type suited to the organic coating applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.
- B. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply air-dried primer specified below immediately after cleaning and pretreatment.
1. Shop Primer: Zinc-dust, zinc-oxide primer paint complying with performance requirements of FS TT-P-641, Type II.

2.8 STEEL SHEET FINISHES

- A. Surface Preparation: Solvent-clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel to comply with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).
- B. Pretreatment: Immediately after surface preparation, apply a conversion coating of type suited to organic coating applied over it.
- C. Factory Priming for Field-Painted Finish: Apply shop primer that complies with ANSI A224.1 acceptance criteria, is compatible with finish paint systems indicated, and has capability to provide a sound foundation for field-applied topcoats. Apply primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
 - 1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
 - 2. In masonry construction, install at least 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
 - 3. At existing concrete or masonry construction, install at least 3 completed opening anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.
 - 4. Install fire-rated frames according to NFPA 80.
- C. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.
 - 1. Fire-Rated Doors: Install with clearances specified in NFPA 80.
 - 2. Smoke-Control Doors: Comply with NFPA 105.

3.2 ADJUSTING AND CLEANING

- A. Prime Coat Touchup: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08110

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings 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 the following:
 - 1. Solid core doors with wood veneer faces.
 - 2. Factory finishing of flush wood doors.
 - 3. Louvers for flush wood doors.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 6 Section "Finish Carpentry" for wood door frames.

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 door, including details of core and edge construction, trim for openings and louvers, and factory-finishing specifications.
- C. Shop drawings indicating location and size of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, requirements for veneer matching and factory finishing and other pertinent data.
 - 1. For factory-machined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.
- D. Samples for initial selection in the form of color charts consisting of actual materials in small sections for the following:
 - 1. Faces of factory-finished doors with transparent finish. Show the full range of colors available for stained finishes.
- E. Samples for verification in the form and size indicated below:
 - 1. Corner sections of doors approximately 12 inches (300 mm) square with door faces and edgings representing the typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.

1.4 QUALITY ASSURANCE

- A. Quality Standard: Comply with the following standard:
 - 1. NWWDA Quality Standard: I.S.1-A, "Architectural Wood Flush Doors," of the National Wood Window and Door Association.
 - 2. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grade of door, core, construction, finish, and other requirements.
- B. Single-Source Responsibility: Obtain doors from one source and by a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's instructions.

1. Comply with Technical Bulletin 420-R for delivery, storage, and handling of doors.

B. Identify each door with individual opening numbers as designated on shop drawings, using temporary, removable, or concealed markings.

1.6 PROJECT CONDITIONS

A. Conditioning: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4 inch (6.35 mm) in a 42-by-84-inch (1067-by-2134-mm) section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span, or do not conform to tolerance limitations of referenced quality standards.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
2. Warranty shall be in effect during the following period of time after date of Substantial Completion.

a. Solid Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide doors by one of the following:

1. Solid Core Doors:
 - a. Algoma Hardwoods Inc.
 - b. Eggers Industries, Architectural Door Division.
 - c. Chappell Door Co.

2.2 INTERIOR FLUSH WOOD DOORS

A. Solid Core Doors for Transparent Finish: Comply with the following requirements:

1. Faces: Rotary Cut Natural Birch
2. Grade: Premium.
3. Construction: 7 ply.
4. Core: Particleboard Core to meet or exceed ANSI/A208.1 for 1-LD-1 or 1-LD-2 door core
5. Bonding: Stiles and rails bonded to core, then entire unit abrasive planed before veneering.

2.3 FABRICATION

A. Fabricate flush wood doors to comply with following requirements:

1. In sizes indicated for job-site fitting.
 2. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels:
 - a. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements of NFPA 80 for fire-resistance-rated doors.
 3. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and hardware templates.
 - a. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory machining.
 - b. Metal Astragals: Pre-machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- B. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Louvers: Factory install louvers in prepared openings.

2.5 FACTORY FINISHING

- A. General: Comply with referenced quality standard's requirements for factory finishing.
- B. Finish wood doors at factory.
- C. Transparent Finish: Comply with requirements indicated for grade, finish system, staining effect, and sheen.
1. Grade: Premium.
 2. Finish: AWI System TR-4 or better

PART 3-EXECUTION

3.1 EXAMINATION

- A. Examine installed door frames prior to hanging door:
1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
 2. Reject doors with defects.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation see Division 8 Section "Door Hardware."
- B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and referenced quality standard and as indicated.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation, if fitting or machining is required at the job site.

3.3 ADJUSTING AND PROTECTION

- A. Operation: Rehang or replace doors that do not swing or operate freely.

- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08211

SECTION 08331 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of electric-motor operated overhead coiling doors:
 - 1. Insulated service doors.

1.3 DEFINITIONS

- A. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
 - 1. Wind Load: Uniform pressure (velocity pressure) of **20 lbf/sq. ft. (960 Pa)**, acting inward and outward.
- B. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 10,000 cycles and for 10 cycles per day.

1.5 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
 - 1. Summary of forces and loads on walls and jambs.
- B. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's product data.
- C. Samples for Verification: Of each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Curtain Slats: **12 inches (305 mm)** long.

2. Bottom Bar: 6 inches (150 mm) long.

D. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.
 1. Obtain operators and controls from overhead coiling door manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

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. Alpine Overhead Doors, Inc.
 2. Atlas Door; Div. of Clopay Building Products Company, Inc.
 3. Cookson Company.
 4. Cornell Iron Works Inc.
 5. Dynamic Closures Corporation.
 6. Mahon Door Corporation.
 7. McKeon Rolling Steel Door Company, Inc.
 8. Metro Door.
 9. Overhead Door Corp.
 10. Pacific Rolling Doors Co.
 11. Raynor.
 12. Southwestern Steel Rolling Door Co.
 13. Wayne-Dalton Corp.
 14. Windsor Door, a MAGNATRAX Corporation.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A 653M, G90 (Z275) coating designation.

- a. Minimum Base-Metal (Uncoated) Thickness: 0.0209 inch (0.55 mm).
 - b. Flat profile slats.
- 2. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.
- 3. Inside Curtain Slat Face: To match material of outside metal curtain slat.
- B. Endlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; galvanized, stainless-steel, or aluminum extrusions to suit type of curtain slats.
 - 1. Astragal: Provide a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene; for placement between angles or fitted to shape, as a cushion bumper for interior door.
- D. Curtain Jamb Guides for Service Doors: Fabricate curtain jamb guides of steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 3/16-inch- (5-mm-) thick galvanized steel sections complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.3 HOODS AND ACCESSORIES

- A. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
 - 1. Fabricate hoods for steel doors of minimum 0.028-inch- (0.7-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
 - 2. Shape: Round.
- B. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous sheet secured to inside of hood.
 - 1. Provide motor-operated doors with combination bottom weatherseal and sensor edge.
- C. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

- D. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.4 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than **0.03 in./ft. (2.5 mm/m)** of span under full load.
- C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.
- D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate.

2.5 ELECTRIC DOOR OPERATORS

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- B. Comply with NFPA 70.
- C. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging chain and sprocket operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- E. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V, ac or dc.
- F. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors complying with NEMA MG 1; with overload protection; sized to start,

accelerate, and operate door in either direction from any position, at not less than **2/3 fps (0.2 m/s)** and not more than **1 fps (0.3 m/s)**, without exceeding nameplate ratings or service factor.

1. Type: Polyphase, medium-induction type.
 2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 3. Coordinate wiring requirements and electrical characteristics of motors with building electrical system.
 4. Provide open dripproof-type motor, and controller with NEMA ICS 6, Type 1 enclosure.
- G. Remote-Control Station: Provide momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
1. Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
- I. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- J. Provide electric operators with ADA-compliant audible alarm and visual indicator lights.

2.6 FINISHES, GENERAL

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STEEL AND GALVANIZED STEEL FINISHES

- A. Factory Primer for Field Finish: Manufacturer's standard primer, compatible with field-applied finish according to coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
 1. Apply to ferrous surfaces except zinc-coated metal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports.

3.2 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08331

SECTION 08400 - ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior entrance systems.
 - 2. Exterior storefront systems.

1.3 SYSTEM DESCRIPTION

- A. General: Provide aluminum entrance and storefront systems capable of withstanding loads and thermal and structural movement requirements indicated without failure, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project. Failure includes the following:
 - 1. Air infiltration and water penetration exceeding specified limits.
 - 2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.
- B. Glazing: Physically and thermally isolate glazing from framing members.
- C. Thermally Broken Construction: Provide systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance.
- D. Wind Loads: Provide entrance and storefront systems, including anchorage, capable of withstanding wind-load design pressures calculated according to requirements of authorities having jurisdiction or the American Society of Civil Engineers' ASCE 7, "Minimum Design Loads for Buildings and Other Structures," 6.4.2, "Analytical Procedure," whichever are more stringent.
 - 1. Deflection of framing members in a direction normal to wall plane is limited to 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller, unless otherwise indicated.
 - 2. Static-Pressure Test Performance: Provide entrance and storefront systems that do not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
 - a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
 - b. Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.
- E. Dead Loads: Provide entrance- and storefront-system members that do not deflect an amount which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.

1. Provide a minimum 1/8-inch clearance between members and top of glazing or other fixed part immediately below.
 2. Provide a minimum 1/16-inch clearance between members and operable windows and doors.
- F. Live Loads: Provide entrance and storefront systems, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
- G. Air Infiltration: Provide entrance and storefront systems with permanent resistance to air leakage through fixed glazing and frame areas of not more than 0.06 cfm/sq. ft. (0.3 L/s/sq. m) of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft. (75.2 Pa).
- H. Water Penetration: Provide entrance and storefront systems that do not evidence water leakage through fixed glazing and frame areas when tested according to ASTM E 331 at minimum differential pressure of 20 percent of inward-acting wind-load design pressure as defined by ASCE 7, "Minimum Design Loads for Buildings and Other Structures," but not less than 6.24 lbf/sq. ft. (299 Pa). Water leakage is defined as follows:
1. Uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
- I. Thermal Movements: Provide entrance and storefront systems, including anchorage, that accommodate thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- J. Structural-Support Movement: Provide entrance and storefront systems that accommodate structural movements including, but not limited to, sway and deflection.
- K. Condensation Resistance: Provide storefront systems with condensation resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.1.
- L. Average Thermal Conductance: Provide thermally broken storefront systems with average U-values of not more than 0.63 Btu/sq. ft. x h x deg F (3.57 W/sq. m x K) when tested according to AAMA 1503.1.
- M. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.
- 1.4 SUBMITTALS
- A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
 - B. Shop Drawings: Show details of fabrication and installation, including details of components, provisions for expansion and contraction, and attachments to other work. For entrance systems, include hardware schedule and indicate operating hardware types, quantities, and locations.

- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for units with factory-applied color finishes.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing entrance and storefront systems similar to those required for this Project and who is acceptable to manufacturer.
- B. Source Limitations: Obtain system through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of entrance and storefront systems and are based on the specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
 - 1. Do not modify intended aesthetic effect, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code--Aluminum."

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of entrance and storefront systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
 - 1. Structural failures including, but not limited to, excessive deflection.
 - 2. Adhesive sealant failures.
 - 3. Cohesive sealant failures.
 - 4. Failure of system to meet performance requirements.
 - 5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 6. Failure of operating components to function normally.
 - 7. Water leakage through fixed glazing and frame areas.
- C. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Butler Manufacturing Company; Vistawall Architectural Products.
 2. EFCO Corporation.
 3. Kawneer Company, Inc.
 4. YKK AP America Inc.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
1. Sheet and Plate: [ASTM B 209](#) ([ASTM B 209M](#)).
 2. Extruded Bars, Rods, Shapes, and Tubes: [ASTM B 221](#) ([ASTM B 221M](#)).
 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 4. Bars, Rods, and Wire: [ASTM B 211](#) ([ASTM B 211M](#)).
 5. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: Complying with [ASTM A 36](#) ([ASTM A 36M](#)) for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or [ASTM A 570](#) ([ASTM A 570M](#)) for hot-rolled sheet and strip.
- C. Glazing as specified in Division 8 Section "Glazing."
- D. Glazing Gaskets: Manufacturer's standard pressure-glazing system of black, resilient glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- E. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- F. Structural Silicone Sealant: Type recommended by sealant and system manufacturers that complies with ASTM C 1184 requirements, is compatible with system components with which it comes in contact, and is specifically formulated and tested for use as a structural sealant.
1. Color: As selected by Architect from manufacturer's full range of colors.
 2. Tensile Strength: [100 psi](#) ([689.5 kPa](#)) minimum.
 3. Provide sealant with modulus of elasticity that will not allow movement of more than 25 percent of joint width, unless less movement is required by structural-sealant-glazed systems' design.
 4. Use neutral-cure silicone sealant with insulating-glass units.
- G. Secondary Sealant: For use as weatherseal, compatible with structural silicone sealant and other system components with which it comes in contact, and that accommodates a 50 percent increase or decrease in joint width at the time of application when measured according to ASTM C 719.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Use neutral-cure silicone sealant with insulating-glass units.

H. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

2.3 COMPONENTS

- A. Doors: Provide manufacturer's standard 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) thick, extruded tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deep penetration and fillet welded or that incorporate concealed tie-rods.
1. Glazing Stops and Gaskets: Provide manufacturer's standard snap-on extruded-aluminum glazing stops and preformed gaskets.
 2. Stile Design: Wide stile; minimum 5 inches wide.
- B. Brackets and Reinforcements: Provide manufacturer's standard brackets and reinforcements that are compatible with adjacent materials. Provide nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Reinforce members as required to retain fastener threads.
 2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing, compatible with adjacent materials, and of type recommended by manufacturer.
- E. Weather Stripping: Manufacturer's standard replaceable weather stripping as follows:
1. Compression Weather Stripping: Molded neoprene complying with ASTM D 2000 requirements or molded PVC complying with ASTM D 2287 requirements.
 2. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing complying with AAMA 701 requirements.

2.4 HARDWARE

- A. General: Provide heavy-duty hardware units indicated in sizes, number, and type recommended by manufacturer for entrances indicated. Finish exposed parts to match door finish, unless otherwise indicated.
- B. Pivot Hinges: Offset-Pivot Hinges: Provide top, bottom, and intermediate offset pivots at each door leaf
- C. Closers, General: Comply with manufacturer's recommendations for closer size, depending on door size, exposure to weather, and anticipated frequency of use.
1. Closing Cycle: Comply with requirements of authorities having jurisdiction or the Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," whichever are more stringent.
 2. Opening Force: Comply with the following maximum opening-force requirements for locations indicated:

- a. Exterior Doors: 15 lbf (67 N).
 - b. Interior Doors: 5 lbf (22.2 N).
- D. Concealed Overhead Closers: ANSI/BHMA 156.4, Grade 2, and as follows:
- 1. Type: Single acting, independently hung, with concealed arm and track.
 - 2. Hold Open: None.
 - 3. Back Check: Adjustable.
 - 4. Positive Dead Stop: Coordinated with hold-open angle, if any, or at angle selected by Architect from manufacturer's standard options.
- E. Door Stops: ANSI/BHMA A156.16, Grade 1, floor- or wall-mounted door stop, as appropriate for door location indicated, with integral rubber bumper.
- F. Cylinders: Cylinders will be provided under Division 08710-Door Finish Hardware.
- G. Thumb Turns: Manufacturer's standard cast-aluminum-alloy, inside thumb-turn cylinders.
- H. Deadlock: Manufacturer's standard mortise deadlock with minimum 1-inch- (25.4-mm-) long throw bolt and complying with ANSI/BHMA A156.5, Grade 1 requirements.
- I. Pull Handles: As selected by Architect from manufacturer's full range of pull handles and plates.
- J. Push Bars: As selected by Architect from manufacturer's full range of full-door-width, single-bar push bars.
- K. Thresholds: At exterior doors, provide manufacturer's standard threshold with cutouts coordinated for operating hardware, with anchors and jamb clips, and not more than 1/2-inch- (12.7-mm-) high, with beveled edges providing a floor level change with a slope of not more than 1:2, and in the following material:
- 1. Material: Aluminum, mill finish.
- L. Weather Sweeps: Manufacturer's standard weather sweep for application to exterior door bottoms and with concealed fasteners on mounting strips.
- 2.5 FABRICATION
- A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
 - B. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
 - C. Prepare components to receive concealed fasteners and anchor and connection devices.
 - D. Fabricate components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
 - E. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

- F. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- G. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- H. Storefront: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- I. Entrances: Fabricate door framing in profiles indicated. Reinforce as required to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units as required for installing hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.
 - 1. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
 - 2. Interior Doors: Provide ANSI/BHMA A156.16 silencers at stops to prevent metal to metal contact. Provide 3 silencers on strike jamb of single-door frames and 2 silencers on head of double-door frames.

2.6 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

2.7 STEEL PRIMING

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying primer.
- B. Surface Preparation: Perform manufacturer's standard cleaning operations to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel.
- C. Priming: Apply manufacturer's standard corrosion-resistant primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of entrance and storefront systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing entrance and storefront systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components to drain water passing joints and condensation and moisture occurring or migrating within the system to the exterior.
- D. Install glazing to comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.
 - 1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
 - 2. Install structural silicone sealant according to sealant manufacturer's written instructions.
 - 3. Mechanically fasten glazing in place until structural sealant is cured.
 - 4. Remove excess sealant from component surfaces before sealant has cured.
- E. Install secondary-sealant weatherseal according to sealant manufacturer's written instructions to provide weatherproof joints. Install joint fillers behind sealant as recommended by sealant manufacturer.
- F. Erection Tolerances: Install entrance and storefront systems to comply with the following maximum tolerances:
 - 1. Variation from Plane: Limit variation from plane or location shown to **1/8 inch in 12 feet; 1/4 inch (6 mm)** over total length.
 - 2. Alignment: Where surfaces abut in line, limit offset from true alignment to **1/16 inch (1.5 mm)**. Where surfaces meet at corners, limit offset from true alignment to **1/32 inch (0.8 mm)**.
 - 3. Diagonal Measurements: Limit difference between diagonal measurements to **1/8 inch (3 mm)**.

3.3 ADJUSTING AND CLEANING

- A. Adjust doors and hardware to provide tight fit at contact points and weather stripping, smooth operation, and weathertight closure.
- B. Remove excess sealant and glazing compounds, and dirt from surfaces.

- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08400

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, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Vision lites.
 - 2. Storefront construction.

1.3 DEFINITIONS

- A. Manufacturer is used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.
- B. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use due to causes other than glass breakage and improper practices for maintaining, and cleaning insulating glass. Evidence of failure is the obstruction of vision by dust, moisture, or film on the interior surfaces of glass. Improper practices for maintaining and cleaning glass do not comply with the manufacturer's directions.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems that are produced, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading (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; and other defects in construction.
- B. Glass Design: Glass thicknesses indicated on Drawings are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for the various size openings in the thicknesses and strengths (annealed or heat-treated) to meet or exceed the following criteria:
 - 1. Minimum glass thickness, nominally, of lites in exterior walls is 6 mm.

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each glass product and glazing material indicated.
- C. Each color of tinted float glass.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.8 WARRANTY

- A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- B. Manufacturer's Warranty on Insulating Glass: Submit written warranty signed by manufacturer of insulating glass agreeing to furnish replacements for insulating glass units that deteriorate as defined in "Definitions" article, f.o.b. point of manufacture, freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer's published instructions.
 - 1. Warranty Period: Manufacturer's standard but not less than 10 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 HEAT-TREATED FLOAT GLASS

- A. Uncoated, Tinted Heat-Treated Float Glass: Gray Lite as manufactured by PPG
 - 1. Kind FT (fully tempered) where indicated.
- B. Manufacturers: Subject to compliance with requirements, manufacturers offering heat-treated glass products that may be incorporated in the Work include the following companies.
 - 1. PPG Industries, Inc.

2.2 INSULATING GLASS PRODUCTS

- A. Sealed Insulating Glass Units: Preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774 and with other requirements indicated.
 - 1. For properties of individual glass lites making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lites of insulating glass units.

2. Provide heat-treated, coated float glass of kind indicated or, if not otherwise indicated, Kind HS (heat strengthened) where recommended by manufacturer to comply with system performance requirements specified and Kind FT (fully tempered) where safety glass is designated or required.
3. Performance characteristics designated for coated insulating glass are nominal values based on manufacturer's published test data for units with lites 6 mm thick and nominal 1/2-inch (13 mm) dehydrated space between lites, unless otherwise indicated.

2.3 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 recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, 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. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass from edge damage during handling and installation as follows:
 1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.
 2. Remove damaged glass from Project site and legally dispose of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

- D. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.
- G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
- B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- C. Install gaskets so they protrude past face of glazing stops.

3.5 PROTECTION AND CLEANING

- A. Protect exterior glass from breakage 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, alkali deposits, or stains, and 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 faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 08800

SECTION 09255 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Gypsum board assemblies attached to wood framing.

1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 ASSEMBLY PERFORMANCE REQUIREMENTS

- A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- B. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.
- B. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

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. Gypsum Board and Related Products:
 - a. Domtar Gypsum.
 - b. Georgia-Pacific Corp.
 - c. National Gypsum Co.; Gold Bond Building Products Division.
 - d. United States Gypsum Co.

2.3 GYPSUM BOARD PRODUCTS

- A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.
 - 1. Widths: Provide gypsum board in widths of 48 inches (1219 mm).
- B. Gypsum Wallboard: ASTM C 36 and as follows:
 - 1. Type: Regular for vertical surfaces, unless otherwise indicated.
 - 2. Edges: Tapered.
 - 3. Thickness: As indicated.

2.4 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
 - 1. Material: Formed metal or plastic, with metal complying with the following requirement:
 - a. Steel sheet zinc coated by hot-dip process or rolled zinc.
 - 2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.

2.5 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.
- C. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.
 - 1. Ready-Mixed Formulation: Factory-mixed product.
 - a. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
 - b. Topping compound formulated for fill (second) and finish (third) coats.

2.6 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Steel drill screws complying with ASTM C 1002 for the following applications:
 - 1. Fastening gypsum board to wood members.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.4 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
- B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- D. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.

- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches (813 mm) wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- I. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
 - 1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

3.5 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:
 - 1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless parallel application is required for fire-resistance-rated assemblies. Use maximum-length panels to minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:
 - 1. Fasten with screws.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install control joints in locations as shown on A100 & A101.
- D. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
 - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

3.7 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.

- C. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.
 - D. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
 - 1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 2 where panels form substrates for tile and where indicated.
 - 3. Level 5 for gypsum board surfaces where indicated.
 - E. Use one of the following joint compound combinations as applicable to the finish levels specified:
 - 1. Embedding and First Coat: Job-mixed, drying-type, taping compound. Fill (Second) Coat: Job-mixed, drying-type, topping compound. Finish (Third) Coat: Job-mixed, drying-type, topping compound.
 - F. Where Level 5 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories; and apply a thin, uniform skim coat of joint compound over entire surface. For skim coat, use joint compound specified for third coat, or a product specially formulated for this purpose and acceptable to gypsum board manufacturer. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.
 - G. Where Level 2 gypsum board finish is indicated, embed tape in joint compound and apply first coat of joint compound.
 - H. Where Level 1 gypsum board finish is indicated, embed tape in joint compound.
- 3.8 CLEANING AND PROTECTION
- A. Promptly remove any residual joint compound from adjacent surfaces.
 - B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09255

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems.

1.3 SUBMITTALS

- A. Product Data: For each type of product specified.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient

temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: See Reflected Ceiling Plan drawing.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements. Exterior grid to be aluminum.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
3. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Comply with paint manufacturer's written instructions for applying and baking and for minimum dry film thickness.
 - a. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).
 - b. Color: white.
4. 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. Armstrong World Industries, Inc.
 - b. Celotex Corporation (The); Building Products Division; Architectural Ceilings Marketing Dept.
 - c. USG Interiors, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
- B. Suspend ceiling hangers from building's structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent

- devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (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 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- 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 fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 2. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
- 3.3 CLEANING
- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

SECTION 09653 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

3.1 RELATED DOCUMENTS

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

3.2 SUMMARY

- A. This Section includes the following:
 - 1. Resilient wall base.
 - 2. Resilient flooring accessories.

3.3 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.

3.4 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.

3.5 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.

3.6 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.

PART 2 - PRODUCTS

3.7 RESILIENT WALL BASE

- A. Rubber Wall Base: Products complying with FS SS-W-40, Type I.

3.9 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.10 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.

3.11 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.

- 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.

3.12 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.
 - 5. Install premolded outside and inside corners before installing straight pieces.
- 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.

3.13 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.
- 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.

Pinnacle Agriculture Holdings, LLC

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 09900 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of the following:
 - 1. Exposed exterior items and surfaces.
 - 2. Exposed interior items and surfaces.
- B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Finished mechanical and electrical equipment.
 - c. Light fixtures.
 - d. Distribution cabinets.
 - 2. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Bronze and brass.
 - 3. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 - 4. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
 - 4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
 - 1. After color selection, the Architect will furnish color chips for surfaces to be coated.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F (7.2 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.
 - 1. Quantity: Furnish the Owner with extra paint materials in the quantities indicated below:
 - a. Exterior, Full-Gloss Alkyd Enamel: 2 gal. of each color applied.
 - b. Interior, eggshell Acrylic Paint: 2 gal. of each color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules.
- B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
 - 1. Devoe & Raynolds Co. (Devoe).
 - 2. Fuller-O'Brien Paints (Fuller).
 - 3. Glidden Co. (The) (Glidden).
 - 4. Benjamin Moore & Co. (Moore).
 - 5. PPG Industries, Inc. (PPG).
 - 6. Pratt & Lambert, Inc. (P & L).

7. Sherwin-Williams Co. (S-W).

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: Provide color selections made by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
- D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the

- manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.
- 3.4 CLEANING
- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
- 3.5 PROTECTION
- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.

1. Full-Gloss, Alkyd-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

- a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils (0.033 mm).

- | | | |
|----|----------|---|
| 1) | Devoe: | 13101 Mirrolac Rust Penetrating Metal Primer. |
| 2) | Fuller: | 621-04 Blox-Rust Alkyd Metal Primer. |
| 3) | Glidden: | 5205 Glid-Guard Tank & Structural Primer, Red. |
| 4) | Moore: | IronClad Retardo Rust-Inhibitive Paint #163. |
| 5) | PPG: | 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer. |
| 6) | P & L: | S 4551 Tech-Gard High Performance Rust-Inhibitor Primer. |
| 7) | S-W: | Kem Kromik Metal Primer B50N2/B50W1. |

- b. First and Second Coats: Full-gloss, exterior, alkyd enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 3.0 mils (0.076 mm).

- | | | |
|----|----------|--|
| 1) | Devoe: | 70XX Mirrolac Interior/Exterior Alkyd-Urethane Gloss Enamel. |
| 2) | Fuller: | 312-XX Heavy-Duty Industrial Maintenance Enamel. |
| 3) | Glidden: | 4500 Series Glid-Guard Alkyd Industrial Enamel. |
| 4) | Moore: | Impervo Enamel #133. |
| 5) | PPG: | 6-282 Speedhide Interior/Exterior Gloss-Oil Enamel. |
| 6) | P & L: | S 4500 Series Tech-Gard Maintenance Gloss Enamel. |
| 7) | S-W: | Industrial Enamel B-54 Series. |

3.7 INTERIOR PAINT SCHEDULE

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Low-Luster, Acrylic-Enamel Finish: 2 finish coats over a primer.

- a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils (0.031 mm).

- | | | |
|----|--------|--|
| 1) | Devoe: | 50801 Wonder-Tones Interior Vinyl Latex Primer-Sealer. |
|----|--------|--|

- | | | |
|----|----------|--|
| 2) | Fuller: | 220-20 Pro-Tech Interior Latex Wall Primer and Sealer. |
| 3) | Glidden: | 5111 Spred Ultra Latex Primer-Sealer. |
| 4) | Moore: | Regal First Coat Interior Latex Primer & Underbody #216. |
| 5) | PPG: | 17-10 Quick-Drying Interior Latex Primer-Sealer. |
| 6) | P & L: | Z/F 1004 Suprime "4" Interior Latex Wall Primer. |

- b. First and Second Coats: Low-luster (eggshell or satin), acrylic-latex, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than **2.8 mils (0.071 mm)**.

- | | | |
|----|----------|---|
| 1) | Devoe: | 34XX Wonder-Tones Interior Latex Eggshell Enamel. |
| 2) | Fuller: | 212-XX AA Enamel Acrylic Latex Eggshell Enamel. |
| 3) | Glidden: | 4100 Series Spred Ultra Eggshell Latex Wall & Trim Paint. |
| 4) | Moore: | Moore's Regal AquaVelvet #319. |
| 5) | PPG: | 89 Line Manor Hall Eggshell Latex Wall and Trim Enamel. |
| 6) | P & L: | Z/F 4000 Series Accolade Interior Velvet. |

B. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss, Alkyd-Enamel Finish: One finish coat over an enamel undercoater and a primer.

- a. Primer: Quick-drying, rust-inhibitive, alkyd-based or epoxy-metal primer, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than **1.5 mils (0.038 mm)**.

- | | | |
|----|----------|---|
| 1) | Devoe: | 13101 Mirrolac Rust Penetrating Metal Primer. |
| 2) | Fuller: | 621-04 Blox-Rust Alkyd Metal Primer. |
| 3) | Glidden: | 5207 Glid-Guard Tank & Structural Primer, White. |
| 4) | Moore: | IronClad Retardo Rust-Inhibitive Paint #163. |
| 5) | PPG: | 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer. |
| 6) | P & L: | S 4551 Tech-Gard High Performance Rust Inhibitor Primer. |
| 7) | S-W: | Kem Kromik Metal Primer B50N2/B50W1. |

- b. Undercoat: Alkyd, interior enamel undercoat or semigloss, interior, alkyd-enamel finish coat, as recommended by the manufacturer for this substrate, applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than **1.2 mils (0.031 mm)**.

- | | | |
|----|----------|---|
| 1) | Devoe: | 26XX Velour Interior Alkyd Semi-Gloss Enamel. |
| 2) | Fuller: | 220-07 Interior Alkyd Enamel Undercoat. |
| 3) | Glidden: | UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel. |
| 4) | Moore: | Moore's Alkyd Enamel Underbody #217. |
| 5) | PPG: | 6-6 Speedhide Interior Quick-Drying Enamel Undercoater. |
| 6) | P & L: | S/D 1011 Suprime "11" Interior Alkyd Wood Primer. |
| 7) | S-W: | ProMar 200 Interior Alkyd Semi-Gloss Enamel B34W200. |

- c. Finish Coat: Odorless, semigloss, alkyd, interior enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.4 mils (0.036 mm).

- | | | |
|----|----------|---|
| 1) | Devoe: | 26XX Velour Interior Alkyd Semi-Gloss Enamel. |
| 2) | Fuller: | 110-XX Fullerglo Alkyd Semi-Gloss Enamel. |
| 3) | Glidden: | UH 8400 Ultra Traditional Alkyd Semi-Gloss Enamel. |
| 4) | Moore: | Satin Impervo #235. |
| 5) | PPG: | 27 Line Wallhide Low Odor Interior Enamel Wall and Trim Semi-Gloss Oil. |
| 6) | P & L: | S/D 5700 Cellu-Tone Alkyd Satin Enamel. |
| 7) | S-W: | Classic 99 Interior/Exterior Semi-Gloss Alkyd Enamel A-40 Series. |

1.1 INTERIOR WOOD STAINS AND VARNISHES

- A. Open-Grain Wood Filler: Factory-formulated paste wood filler applied at spreading rate recommended by manufacturer.
1. Benjamin Moore; Benwood Paste Wood Filler No. 238.
 2. Coronado; none required.
 3. ICI Dulux Paints; none required.
 4. Kelly-Moore; none required.
 5. M. A. B. Paint; Paste Wood Filler.
 6. Pittsburgh Paints; none required.
 7. Sherwin-Williams; Sher-Wood Fast-Dry Filler.
 8. Sherwin-Williams; none recommended.
- B. Interior Wood Stain: Factory-formulated alkyd-based penetrating wood stain for interior application applied at spreading rate recommended by manufacturer.
1. Benjamin Moore; Benwood Penetrating Stain No. 234.
 2. Coronado; 3601-Line Quick-Seal Alkyd Stain.
 3. ICI Dulux Paints; 1700-XXX WoodPride Interior Solventborne Wood Finishing Stain.
 4. Kelly-Moore; McCloskey Stain.
 5. M. A. B. Paint; Wood Stain 062 Line.
 6. Pittsburgh Paints; 77-560 Rez Interior Semi-Transparent Oil Stain.
 7. Sherwin-Williams; Wood Classics Interior Oil Stain A-48 Series.
- C. Clear Sanding Sealer: Factory-formulated fast-drying alkyd-based clear wood sealer applied at spreading rate recommended by manufacturer.
1. Benjamin Moore; Moore's Interior Wood Finishes Quick-Dry Sanding Sealer No. 413.
 2. Coronado; 81-10 Dual Seal.
 3. ICI Dulux Paints; 1902-0000 WoodPride Interior Satin Polyurethane Varnish.
 4. Kelly-Moore; 2164 E Z Sand Alkyd Q. D. Sealer.
 5. M. A. B. Paint; Minit Dri Sanding Sealer 037-005 Line.
 6. Pittsburgh Paints; 6-10 SpeedHide Quick-Drying Interior Sanding Wood Sealer and Finish.
 7. Sherwin-Williams; Wood Classics Fast Dry Sanding Sealer B26V43.

- D. Interior Alkyd- or Polyurethane-Based Clear Satin Varnish: Factory-formulated alkyd- or polyurethane-based clear varnish.
1. Benjamin Moore; Benwood Interior Wood Finishes Polyurethane Finishes Low Lustre No. 435.
 2. Coronado; 67-100 Polyurethane Liquid Plastic Satin Varnish.
 3. ICI Dulux Paints; 1902-0000 WoodPride Interior Satin Polyurethane Varnish.
 4. Kelly-Moore; 2050 Kel--Aqua Stain Base.
 5. M. A. B. Paint; Rich Lux Water Based Satin Polyurethane.
 6. Pittsburgh Paints; 77-7 Rez Varnish, Interior Satin Oil Clear.
 7. Sherwin-Williams; Wood Classics Fast Dry Oil Varnish, Satin A66-300 Series.

END OF SECTION 09900

SECTION 10520 – ALUMINUM CANOPIES

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. Aluminum Canopies

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show edge details, drainage systems and member sizes.
- C. Samples for Verification: Of type and color specified. Provide 12” long section of edge detail and typical column.

PART 2 - PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Superior Metal Products Company
 - 2. Dittmer Architectural Aluminum
 - 3. Mapes Architectural Products

2.2 PRODUCT AND MATERIALS

- A. Decking to be extruded aluminum equal to Flush Decking by Superior Metal Products Company. Decking to be .062 6063-T6 extruded aluminum decking with smooth underside. Color to be Dark Bronze. All drainage to be internal with water exiting through the base of the columns.

2.3 INSTALLATION AND ERECTION

- A. Canopies shall be installed according to approved plans and shop drawings and the entire structure shall be erected straight, true and plumb in accordance with standard construction procedures. Provide necessary blockouts, flashing and other items required to be built-in. All

joints and connections shall be tight and clean, and all surfaces of work left in a clean condition.

END OF SECTION 10520

SECTION 10520 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes.
- C. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.
 - 1. Size: 6 by 6 inches (150 by 150 mm) square.
- D. Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

- 1. Provide fire extinguishers approved, listed, and labeled by FMG.

- D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.

- 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 3. Basis-of-Design Product: The design for each product is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: **ASTM B 209** (**ASTM B 209M**).
 - 2. Extruded Shapes: **ASTM B 221** (**ASTM B 221M**).
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class **1 (clear)**

2.3 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Amerex Corporation.
 - 2. Ansul Incorporated.
 - 3. Badger Fire Protection.
 - 4. Buckeye Fire Equipment Company.
 - 5. Fire End & Croker Corporation.
 - 6. General Fire Extinguisher Corporation.
 - 7. JL Industries, Inc.
 - 8. Kidde Fynetics.
 - 9. Larsen's Manufacturing Company.
 - 10. Modern Metal Products; Div. of Technico.
 - 11. Moon American.
 - 12. Potter Roemer; Div. of Smith Industries, Inc.
 - 13. Watrous; Div. of American Specialties, Inc.
- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet indicated.
 - 1. Valves: Manufacturer's standard
 - 2. Handles and Levers: Manufacturer's standard
- C. Multipurpose Dry-Chemical Type in Steel Container : UL-rated **4-A:60-B:C**, **10-lb (4.5-kg)** nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.4 FIRE-PROTECTION CABINET

- A. Manufacturers:
 - 1. Fire End & Croker Corporation.
 - 2. General Accessory Mfg. Co.
 - 3. JL Industries, Inc.
 - 4. Kidde Fynetics.

5. Larsen's Manufacturing Company.
6. Modern Metal Products; Div. of Technico.
7. Moon American.
8. Potter Roemer; Div. of Smith Industries, Inc.
9. Watrous; Div. of American Specialties, Inc.

- B. Cabinet Type: Suitable for fire extinguisher
- C. Cabinet Construction: 1-hour fire rated
- D. Cabinet Material: Stainless-steel sheet.
 1. Shelf: Same metal and finish as cabinet.
- E. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
 1. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
- F. Cabinet Trim Material: Stainless-steel sheet
- G. Door Material: Stainless-steel sheet
- H. Door Style: Fully glazed panel with frame
- I. Door Glazing: Tempered float glass (clear)
- J. Finishes:
 1. Stainless Steel: No. 6 finish.

2.5 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Construct fire-rated cabinets with double walls fabricated from **0.0428-inch- (1.1-mm-)** thick, cold-rolled steel sheet lined with minimum **5/8-inch- (16-mm-)** thick, fire-barrier material.
 - a. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch (13 mm)** thick.
 2. Miter and weld perimeter door frames.

- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STEEL FINISHES

- A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

2.8 STAINLESS-STEEL FINISHES

- A. General: Remove tool and die marks and stretch lines or blend into finish.
 - 1. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Satin, Directional Polish: No. 6 finish.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire-Protection Cabinets: **54 inches (1372 mm)** above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10520

SECTION 10801 - TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Toilet and bath accessories.

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.
- C. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
 - 1. Products of other manufacturers with equal characteristics, as judged solely by Architect, may be provided.
 - 2. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
 - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:
 - 1. Toilet and Bath Accessories:
 - a. A & J Washroom Accessories, Inc.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.
 - e. General Accessory Manufacturing Co. (GAMCO).
 - f. McKinney/Parker Washroom Accessories Corp.
- B. 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 Toilet and Bath Accessory Schedule at the end of Part 3.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- E. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

- A. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- B. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.
- C. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
 - 1. Provide galvanized steel backing sheet, not less than 0.034 inch (0.85 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- D. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
- E. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

- A. Paper Towel Dispenser: Bradley model #235 (or equal). Provide one unit per toilet room.
- B. Toilet Tissue Dispenser: Bradley model #5241 (or equal). Provide one unit per toilet room.
- C. Soap Dispenser: Bradley model #6562 (or equal).: Provide one unit per toilet room.
- D. Grab Bar: Bradley model “812 series” (or equal). Each h.c. toilet receives one (1) 36” grab bar and one (1) 42” grab bar.
- E. Mirror Unit: Bradley model #781 (or equal). Size to be 24” x 30”. Provide one mirror unit in each single fixture toilet room.

END OF SECTION 10801

SECTION 01010 SUMMARY OF WORK

PART 1 - GENERAL

1.01 LOCATION AND SUMMARY OF WORK

- A. All of the work of this Contract is located on property owned or Leased by Pinnacle Agricultural Holdings LLC, located at the address specified on the Cover sheet of drawings.

The Contractor shall provide services for demolition, site preparation and earthwork, installation of new concrete driveway and other site improvements, power and water supply, site clearing, preparing the building and driveway subgrade, constructing concrete slab, walkways, and driveways, all building foundation, all structural, electrical and mechanical work, installation of water supply extension, all final yard grading for positive flow, sodding all disturbed areas, planting trees, and all other appurtenances and project components necessary for a complete facility in place, certified for occupancy and operation. The building configuration (i.e. location of doors, size and location of conditioned room, etc.) shall remain as depicted on the plans.

- B. Contractor will coordinate with the local Utilities to tap into the existing water, sewer and gas lines and pay any fees associated with the connection if required by the utility provider.
- C. Contractor will coordinate with the power supply company to install power supply line. The Contractor shall pay any fees required by the power supply company to install the electrical supply line and the meter on the building, and a transformer if one is needed.

1.02 WORK TO BE DONE BY CONTRACTOR

- A. The Contractor shall furnish all labor, materials, equipment, tools, services and incidentals to complete all Work required by these Specifications and as shown on the Drawings. The project includes completing the design of the proposed PEM Building. The Contractor shall complete the design, and furnish and install buildings, along with concrete foundation and slab, sidewalks, driveways and all other site work. The building work shall include all foundation, structural, footing and slab, plumbing, electrical, heating ventilation, air conditioning, lighting, fire alarm system, and cleanup work as shown on the Drawings and as specified herein. The site work shall include all earthwork and site grading, new concrete driveway, utilities, sodding and planting trees, and site restoration.
- B. Materials and "Approved Equal" Products: Materials shall be new, of quality specified, and delivered in a timely manner to prevent delay of work. It is not the intent of these specifications to restrict the selection of materials and equipment, but to provide a standard of workmanship and performance. Where a particular system, product or material is specified by name, it shall be considered as best

suited because of quality, appearance or function in the work. Other products considered equal to the specified item by the contractor may be used, provided the following method is employed:

- a. If a bidder believes his/her product to be equivalent in kind, quality, function, etc. then he/she shall submit a request for approval with adequate supporting technical data to the Owner / Owner's Representative not less than 10 days before bid opening. Approval by the Owner / Owner's Representative will be in the form of an addendum to the specifications issued to all prospective bidders clearly stating that the additional product brand or brands are equivalent to those specified and acceptable for use on the proposed project. It shall be clearly understood by the contractor that the Owner decision regarding those items submitted under these terms for approval as equals shall be binding and final on all stakeholders concerned.
- C. Reference Specifications: Reference specifications of the American Society for Testing and Materials (A.S.T.M.) and other standard specifications or codes mentioned herein indicate requirements to be conformed with. Such references apply to current editions, including addenda and errata, if any unless otherwise specified and/or noted.
- D. Manufacturer's Specifications: Reference to a specific manufacturer by trade name establishes the standard of material acceptable to the Owner / Owner's Representative. Execute work in accordance with manufacturer's specifications and printed instructions except where otherwise specified and/or noted.
- E. The Contractor shall perform the Work complete, in place and ready for continuous service, and shall include testing, permits, cleanup, replacements, and restoration required as a result of damages caused during the building construction.
- F. All materials, equipment, skills, tools and labor which is reasonable and properly inferable and necessary for the proper completion of the Utilities Warehouse Building in a substantial manner and in compliance with the requirements stated or implied by these Specifications or Drawings shall be furnished and installed by the Contractor without additional compensation, whether or not specifically indicated in the Contract Documents.
- G. The Contractor shall comply with all Municipal, County, State, Federal and other codes and regulations applicable to the above construction work.
- H. The Contractor shall pay for all quality control testing to the building structure and site work. The Owner will pay for the quality assurance testing during construction provided the tests pass. Contractor will pay for all failed tests, stand-by time charges, not-ready for test charges, and any of the Owner's retesting because of the original test samples failing to meet the specification requirements. Owner will subtract these charges by the Owner's testing company from the Contractor's monthly pay request. Contractor shall coordinate all test requests with the Owner's testing company.

- I. Contractor shall pay for all soil, sub grade and building base compaction testing.
- J. The Contractor will be responsible for any and all traffic control around the construction area including constructing any by-pass roads to avoid construction areas.

1.03 WORK BY OWNER

- A. Owner will continue the operations at the facility. Owner will continue the use of the access road that runs adjacent to the construction area. Therefore, the access road must be kept open and the Contractor is to furnish flagmen and/or all weather bypass lanes when necessary.
- B. The Contractor will perform quality assurance testing. These include compaction testing, concrete testing, and other testing and construction observation of the material and equipment components as required by the Technical Specifications. The Contractor will pay for all required quality assurance tests and will require the testing laboratory to directly provide the Owner with the test results within 24-hours of the testing. The cost to the Contractor for such testing shall be included in the lump sum contract.
- C. The Contractor will pay for all failed quality assurance tests and any “not-ready” stand-by charges. The Contractor shall perform and pay for all quality control testing including testing required by the building permit and provide a copy of the results to the Owner.

1.04 Not Used

1.05 Not Used

1.06 SITE CONDITIONS

- A. The Contractor is encouraged to visit the site and evaluate the existing site condition and perform any test that he may deem necessary in preparation of his bid for the final design, permitting and construction of this project.

1.07 WORK SEQUENCE

- A. The Contractor shall organize and plan the construction activities to assure the safety and reliability of and to minimize the interruption to the water system and all other utilities.
- B. The proposed Work sequence shall be submitted to the Owner in the Project Schedule as required.

1.08 CONTRACTOR'S USE OF PREMISES

- A. The Contractor shall assume full responsibility for the protection and safekeeping of products and materials stored at the job site. If additional storage or work areas are required they shall be obtained by the Contractor at no additional cost to the Owner.

1.09 DISCREPANCY BETWEEN DRAWINGS AND SPECIFICATIONS

- A. In case of any discrepancy between the Drawings and Specifications, the more stringent requirement shall apply. The Contractor will not be held responsible for the discovery of such discrepancy, but any work done on the item involved after such discovery, and prior to authorization by the Engineer, will be done at the Contractor's risk and expense.

1.10 PRE-CONSTRUCTION CONFERENCE

- A. This meeting is intended to introduce the various key personnel from each organization and to discuss the Contract Documents, the start of construction, order of work, labor and legal requirements, insurance requirements, names of the major subcontractors, method of payment, shop drawing requirement, protection of existing facilities and other pertinent items associated with the Project. The Contractor shall bring to this conference four (4) copies of his proposed work schedule.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION (Not used)

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

SECTION 02100 SITE PREPARATION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work consists of furnishing all labor, material and equipment necessary for the removal of all vegetation, waste materials and unsuitable materials from the existing designated Vehicle Maintenance Facility limits of Construction and all other areas within the project limit line as shown on the drawings and as required for the new construction.
- B. All waste generated as a result of site preparation is required to be reused or disposed on-site in a location as directed by the Owner.
- C. The work under this section is not inclusive of the work required by the recommendations of the Subsurface Exploration Report in Appendix A of the project manual.

1.02 DEFINITIONS

- A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- B. Grubbing: Removal of vegetation and other organic matter including stumps, muck, buried logs, roots, root mats, organic topsoil, and other deleterious material to a minimum depth of 6 inches below subgrade and 5 feet beyond the edges of proposed pavements.
- C. Stripping: Removal of topsoil remaining after applicable scalping is completed.

1.03 SEQUENCING

- A. Prepare site only after adequate erosion and sediment controls are in place. Limit areas exposed during installation of temporary erosion and sediment controls to one acre.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 DEMOLITION & SITE GRADING

- A. The Owner will remove the temporary storage units currently on-site prior to start of construction.
- B. The wooden part of the existing dock to be removed by the Contractor and disposed of at the Transfer Station's tipping floor. It is noted the wooden part of the dock may have been constructed with CCA treated wood.
- C. The Contractor shall clear and strip all the area within the limits of construction as required to complete the work. The area to be cleared is limited to the construction limit lines as indicated on the plans.

- D. The top soil and any unsuitable soil need to be stripped within the building footprint area and replaced with fill from on-site stockpile.
- E. All site preparation shall be done in accordance with FDEP permits and in coordination with the Owner.
- F. All structural fill required for this project shall be provided by the Contractor from off-site.

3.02 PROTECTION

- A. Locate, identify, and protect from damage all utilities that remain.
- B. Protect trees, plant growth, and features designated to remain as final landscaping.
- C. Protect and maintain bench marks, monuments and other reference points. Re-establish, at no cost to the Owner, any such reference points if disturbed or destroyed. The Contractor's surveyor shall conduct a survey of all monuments and property markers within construction area prior to any disturbance such as they can be re-established after completion of the Work by the Contractor as part of this Contract.
- D. Protect and maintain all existing monitoring wells, piezometers, landfill gas vents, and fences as shown on the Contract Drawings.
- E. Protect existing facilities, utilities, and structures from damage due to construction.

3.03 JOB CONDITIONS

- A. Conduct site clearing and initial preparation operations to ensure minimum interference with landfill operations.
- B. Do not close or obstruct roads or Owner-operated areas. Do not drive on top of the previously closed areas.
- C. Coordinate with the Owner throughout system disconnects and site preparations.
- D. Provide protection necessary to prevent damage to existing improvements indicated to remain in place. Restore damaged improvements to their original condition, as acceptable to parties having jurisdiction

3.04 DISPOSAL OF WASTE MATERIALS

- A. Burning is not permitted on site.
- B. Construction generated waste shall be transported to the Tomoka Farms Road landfill for proper disposal. Tipping fees will be charges.
- C. Other solid waste originating onsite as result of site preparation, site grading, erosion washouts, and other site construction related work by the Contractor shall be disposed in the County landfill located in Tomoka Farms Road, or in a location as directed by the Owner. There will be a tipping fee charge to the Contractor for disposal of waste delivered to the landfill.

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

**SECTION 02220
EARTHWORK**

PART 1 – GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. The work included under this Section consists of furnishing all labor, materials, equipment and incidentals necessary to perform all excavation, removal of unsuitable material, backfill, fill and grading required to complete the work shown on the Drawings and specified herein.
2. The work shall include, but not necessarily be limited to, all excavation and trenching; all backfilling; embankment and grading; disposal of waste and surplus materials; and all related work such as sheeting, bracing, dewatering, all earthwork and all other requirements shown on the drawings and specified herein.

B. Definitions:

1. Degree of compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557. The dry density and moisture content shall be measured in accordance with ASTM D 2922, Method B, and ASTM D 3017, respectively. The term "maximum density" shall mean the maximum density determined under ASTM D1557.
2. Rock Excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery.
3. Suitable: Suitable materials for fills shall be a non-cohesive, non-plastic granular local sand which shall be free from vegetation, organic material, marl, silt or muck. The Contractor shall furnish all additional fill material required.
4. Undercut Excavation: Undercut excavation shall consist of the removal and satisfactory disposal of all unsuitable material located below subgrade elevation. Where excavation to the finished grade section results in a subgrade or slopes of muck, peat, matted roots, etc., the Contractor shall remove such material below the grade shown on the plans or as directed; and areas so excavated shall be backfilled with approved select borrow.
5. Unsuitable: Unsuitable materials are highly organic soil (peat or muck) classified as A-8 in accordance with AASHTO Designation M 145.

C. Plan for Earthwork

1. The Contractor shall be responsible for having determined to his satisfaction, prior to the submission of his bid, the conformation of the ground, the character and quality of the substrata and the stockpiled fill provided on-site by the Owner, the types and quantities of materials to be encountered, the nature of the groundwater conditions, the prosecution of the work, the general and local conditions and all other matters which can in any way affect the work under this Contract according to the General Conditions.
2. Prior to commencing the excavation, the Contractor shall submit a plan of his proposed operations to the Engineer for review. The Contractor shall reflect the equipment and methods to be employed in the excavation. No claims for extras based on substrata or groundwater table conditions will be allowed. No on-site borrow is available for this construction. The Contractor is required to secure an out side borrow source *which* can meet the requirements of these specifications, drawings and contract documents for this project.
3. No on-site borrow is available for this construction. The Contractor is required to secure an off-site borrow source which can meet the requirements of these specifications, drawings and contract documents for this project.
4. The Contractor is advised and encouraged to examine all outside borrow sources and perform all laboratory testing as maybe necessary as part of his Bid preparations taking into considerations all requirements of this construction.
- D. Trench Safety Act: The Contractor shall comply with all of the requirements of the Florida Trench Safety Act (Chapter 90-96, CS/CB 2626, laws of Florida). The Contractor shall acknowledge that included in various items of his bid proposal and in the total bid price are costs for complying with the provisions of the Act. Additionally, the Contractor is required to break out the costs for complying with the Florida Trench Safety Act.

1.02 RELATED WORK

A. Section 02100 – Site Preparation

Section 02221 – Trenching, Backfilling, and Compacting for Utilities

Section 02270 – Erosion Control

Section 02930 – Sodding

1.03 APPLICABLE PUBLICATIONS

A. American Society for Testing and Materials

ASTM C 33 Concrete Aggregates

ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates Sieve Analysis of Fine and Coarse Aggregate

ASTM D 422 Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)

ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³) (Standard Proctor)
ASTM D 1556	Standard Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (Modified Proctor)
ASTM D1883	Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2049	Standard Method of Test for Relative Density of Cohesionless Soils
ASTM D2167	Standard Method of Test for Density of Soil in Place by the Rubber-Balloon Method
ASTM D 2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D 4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

B. American Association of State Highway & Transportation Officials

AASHTO T 99	The Moisture-Density Relations of Soils using a 5.5-pound hammer and a 12-inch drop
AASHTO T 180	The Moisture Density Relations of Soils using a 10-pound hammer and an 18-inch drop
AASHTO M 145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes

1.04 QUALITY ASSURANCE

- A. The Contractor shall retain the services of a Florida licensed Geotechnical Engineer and geotechnical firm to provide inspection and testing services during the site preparation procedures for confirmation of the adequacy of the earthwork operations. Field tests and observations include verification of foundation, utility, and pavement subgrades by monitoring excavation of unsuitable soils, monitoring

proof-rolling operations, and performing quality assurance tests of the placement of completed structural fill and pavement courses.

- B. All earthwork and related installations shall be performed in accordance with the requirements of these Specifications and the "Subsurface Exploration" Report. Contractor shall fully understand and comply with the requirements of this Report which is included in Appendix A of this Document.
- C. Costs for all testing of materials shall be paid by the Contractor.

1.05 FEDERAL AND STATE REGULATORY REQUIREMENTS

- A. All trench excavations which exceed 4 feet in depth shall comply with the applicable trench safety standards as stated in the OSHA excavation safety standards 29 CFR S.1926.650 Subpart P as regulated and administered by the Florida Department of Labor and Employment Security as the "Florida Trench Safety Act."

1.06 JOB CONDITIONS

- A. If, in the opinion of the Engineer, conditions encountered during construction warrant a change in the footing elevation, or in the depth of removal of unsuitable material from that indicated in the soils report, an adjustment will be made in the contract price, as provided in the General and Special Conditions.

1.07 PROTECTION

- A. Pre-Construction Survey:
 - 1. Prior to commencing excavation, backfill or dewatering, the Engineer and Contractor shall jointly conduct a survey of those existing structures which, in the opinion of the Engineer, may be subject to settlement or distress resulting from excavation or dewatering operations.
 - 2. The Engineer will monitor the structures surveyed to ascertain evidence of settlement or distress. If settlement or distress becomes evident the Contractor shall be required to repair the structures to the previous condition to the satisfaction of the Engineer. Costs shall be paid by the Contractor.
- B. The Contractor shall, at all times during construction, provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. Dewatering shall be conducted in such a manner as to preserve the undisturbed bearing capacity and composition of the subgrade soils at the proposed bottom of the excavation. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed so that the stability of the bottom and sides of the excavations is maintained.
- C. The Contractor shall install and maintain all erosion control features, (i.e., silt fences around all areas downslope of soil disturbance, and wetland boundaries).

Other areas which may require erosion protection or silt fences shall be identified by the RPR during construction. Silt fences shall not be removed until the contained areas are successfully re-vegetated.

1.08

SUBMITTALS

- A. Submit to the Engineer for review the proposed methods of construction, including dewatering, excavation, bedding, filling, compaction and backfilling for the various portions of the work. Review shall be for method only. The Contractor shall remain responsible for the adequacy and safety of the methods.
- B. For granular fill specified in Part 2 of this Specification Section, the Contractor shall submit the information listed below to the RPR and the Engineer the following information and samples a minimum of 14 days prior to starting construction.
 - 1. The proposed material source.
 - 2. The results of grain-size analyses conducted on the proposed material in accordance with ASTM D 422.
 - 3. The results of a moisture-density relation test (ASTM D 698).
 - 4. A 50-pound sample of the proposed granular fill.

The testing results for the above submittals shall be certified by an independent laboratory and paid for by the Contractor.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. All fill material from on-site sources shall be subject to review by the Contractor's Engineer for suitability as foundation and subgrade.
 - 2. Fill material will free of organic material, roots, trash, or other objectionable material. Excess or unsuitable material as designated by the Engineer shall be removed from the job site by the Contractor.
- B. Fill and Backfill: Selected clean fine sand materials (or "granular fill materials") approved by the Geotechnical Engineer from the site excavation or off site borrow. This clean fine sand shall be:
 - 1. Classified as SP in accordance with ASTM D2487.
 - 2. Free of rubble, debris, roots, vegetation, or other deleterious materials.
 - 3. Organic content less than 5 percent by weight per ASTM D2974.
- C. Gravel Base (or "coarse aggregate") Under Building Floor Slabs-On-Grade: Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No. 57, ¾ inch to No. 4. Minimum 6 inch thick (depth) directly below slab.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

- A. The minimum frequency of quality control testing is as provided in these specifications or as set during construction by the Owner. Frequency of testing for field Quality Control shall be the same as defined for conformance testing.
- B. Sampling locations may be selected by the Geotechnical Engineer. If necessary, the location of routine in-place moisture content and dry density test shall be determined using a non-biased sampling plan.
- C. An increased testing frequency shall be used at the discretion of the Engineer when visual observations of construction performance indicate a potential problem.
- D. All perforations resulting from testing the subgrade or embankment shall be filled by the Contractor with soil compacted to the satisfaction of the Geotechnical Engineer.
- E. If a defective area is discovered in the earthwork the Geotechnical Engineer will determine the extent and nature of the defect and notify the Contractor and Owner. If the defect is indicated by an unsatisfactory test result, the Geotechnical Engineer shall determine the extent of the defective area by additional tests, observations, a review of record, or other means. The Contractor shall be responsible for the cost of these additional tests. If the defect is related to material, and/or adverse site conditions, such as overly wet soils or surface desiccation, the Engineer will define the limits and nature of the defect.
- F. After determining the extent and nature of a defect, the Contractor shall correct the deficiency to the satisfaction of the Engineer. The cost of corrective actions shall be borne by the Contractor.
- G. Additional testing shall be performed to verify that the defect has been corrected before any additional work is performed by the Contractor in the area of the deficiency. The Contractor shall be responsible for the cost of these additional tests.

3.02 PROTECTION

- A. Sheeting and Bracing:
 - 1. Furnish, put in place, and maintain sheeting and bracing as required to support the sides of excavations, to prevent movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures, and to protect workers from hazardous conditions or other damage. Such support shall consist of braced steel sheet piling, braced wood lagging and soldier beams or other approved methods. If the Owner is of the opinion that sufficient or proper supports have not been provided, he may order additional supports be installed at the expense of the Contractor, and compliance with such order shall not relieve

or release the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids beside the sheeting, but if voids are formed, they shall be immediately filled and compacted. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill at no additional expense to the Owner.

2. The Contractor shall construct sheeting outside the neat lines of the foundation unless deemed desired otherwise for his method of operation. Sheeting shall be plumb and securely braced and tied in position. Sheeting and bracing shall withstand all pressure to which the structure or trench will be subjected. Any deformation shall be corrected by the Contractor at his own expense so as to provide the necessary clearances and dimensions.
3. Where sheeting and bracing is required to support the sides of excavations for structures, the Contractor shall engage a Professional Geotechnical Engineer, registered in the State of Florida, to design the sheeting and bracing. The sheeting and bracing installed shall conform with the design, and certification of this shall be provided by the Professional Geotechnical Engineer.
4. The installation of sheeting, particularly by driving or vibrating, may cause distress to existing structures. The Contractor shall evaluate the potential for such distress and, if necessary, take all precautions to prevent distress of existing structures because of sheeting installation.
5. The Contractor shall leave in place to be embedded in the backfill, all sheeting and bracing not shown on the Drawings but which the Owner directs him in writing to leave in place at any time during the progress of the work for the purpose of preventing injury to structures, utilities, or property, whether public or private. The Owner may direct that timber used for sheeting and bracing be cut off at any specified elevation.
6. All sheeting and bracing not left in place shall be carefully removed in such manner as not to endanger the construction, or other structures, utilities, or property. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted for that purpose, or otherwise directed by the Owner.
7. The right of the Owner to order sheeting and bracing left in place shall not be construed as creating any obligation on his part to issue such orders, and his failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
8. No wood sheeting is to be withdrawn if driven below mid-diameter of any pipe, and under no circumstances shall any wood sheeting be cut off at a level lower than 1 foot above the top of any pipe.

B. Pumping and Drainage:

1. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels. The Contractor shall engage a Professional Geotechnical Engineer registered in the State of Florida, to design the dewatering systems for all structures and sewer/utility trenches. The Contractor shall submit to the Engineer for review a plan for dewatering systems prior to commencing work. The installed dewatering system shall be in conformity with the overall construction plan, and certification of this shall be provided by the Professional Geotechnical Engineer. The Professional Geotechnical Engineer shall be required to monitor the performance of the dewatering systems during the progress of the work and require such modifications as may be required to assure that the systems are performing satisfactorily.
2. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at the bottom of the excavation and to preserve the integrity of adjacent structures. Well or sump installations shall be constructed with proper sand filters to prevent intermixing of finer grained soil from the surrounding ground.
3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and pumped from the excavation to maintain a bottom free from standing water.
4. The Contractor shall take all additional precautions to prevent buoyant uplift of any structure during construction.
5. The conveying of dewatered liquids in open ditches or trenches will not be allowed. Permission to use any storm sewers, or drains, for water disposal purposes shall be obtained from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. The Contractor shall not cause flooding by overloading or blocking up the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Any damage to facilities shall be repaired or restored as directed by the Owner or the authority having jurisdiction, at no cost to the Owner.
6. Flotation shall be prevented by the Contractor by maintaining a positive and continuous operation of the dewatering system. The Contractor shall be fully responsible and liable for all damages which may result from failure of this system.

7. Removal of dewatering equipment shall be accomplished after the system is no longer required; the material and equipment constituting the system shall be removed by the Contractor.
8. The Contractor shall take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater quality.

3.03 STOCKPILING

- A. Prior to the start of delivery of soil material to the project site, the Contractor shall prepare a sketch and a written stockpiling plan. The plan shall indicate the location of stockpiling areas for different material (e.g. granular fill, top soil material, stone, coarse aggregate, etc.) This plan shall also include temporary roads, protection against weather and erosion, and must be reviewed for approval by the RPR and Engineer prior to any delivery to the site. RPR's or Engineer's review of the Contractor's plan will not relieve the Contractor of supplying and installing materials as specified.
- B. The proposed staging/stockpiling area was previously used by the Owner for yard waste mulching operations. If the Contractor plans to use this area as a stockpiling area for granular fill, the area would need to be prepared so that existing mulch or yard waste could not contaminate the granular fill proposed to be used for construction. Contractor is required to present a plan for preparation of this area for approval by the Engineer and RPR. Stored materials classified as granular fill shall be stockpiled in designated areas free of incompatible soil, debris, roots or other objectionable materials.
- C. Excavated material classified as spoil shall be segregated from granular fill and stockpiled in an area in the landfill as directed by the Owner for disposal and use by the landfill operations.
- D. Stockpiles of fill or spoil shall be no steeper than 3:1 (horizontal: vertical), graded to drain, sealed by tracking parallel to the slope with a dozer or other means approved by the RPR. Stockpiles shall be recontoured daily during periods when fill is taken from the stockpile. The Contractor may cover fill stockpiles with plastic sheeting or other material approved by the Engineer in order to preserve the moisture content of the fill.

3.04 EXCAVATION

- A. Excavating for Structures:
 1. Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.
 2. The site shall be graded to drain as shown on the plans and will require the contractor to excavate some portions of the site and fill others. The

Contractor shall provide a surveyor to determine excavation or fill required in the area to meet the lines and grades presented on the plans.

3. Excavation shall be made to such dimensions as will give suitable room for bracing and supporting, for pumping and draining, for installing foundations, and for all other work required.
 - a) Excavation for precast or prefabricated structures shall be carried to an elevation 2 feet lower than the proposed outside bottom of the structure to provide space for the structural backfill material.
 - b) Excavation for structures constructed or cast-in-place in dewatered excavations shall be carried down to the bottom of the structure where dewatering methods are such that a dry excavation bottom is exposed and the naturally occurring material at this elevation leveled and left ready to receive construction. Material disturbed below the founding elevation in dewatered excavations shall be replaced with Class B concrete.
 - c) Remove unsuitable subgrade soils located below the foundations. The bottom of the over excavation shall be located outside the exterior limits of the foundations around the perimeter of the structure the following horizontal distance, whichever is greater:
 - Distance equal to the depth of over excavation below bottom of foundations, or
 - 10 feet, or
 - As directed by Geotechnical Engineer and Engineer.
 - d) Notify Geotechnical Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected and tested. Do not commence further construction until subgrade has been inspected and approved as being free of desirable material, being of compaction density required by the specifications, and being capable of supporting the allowable respective foundation.
4. Immediately document the location, elevation, size, material type and function of all new subsurface installations, and utilities encountered during the course of construction.
5. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Drawings and should anticipate the encounter of unknown obstructions during the course of the work.
6. Encounters with subsurface obstructions shall be hand excavated.
7. Excavation and dewatering shall be accomplished by methods which preserve the undisturbed state of subgrade soils. Subgrade soils which become soft, loose, "quick" or otherwise unsatisfactory for support of the

proposed structures as a result of inadequate dewatering or other construction methods, shall be removed and replaced by crushed stone as required by the Engineer at the Contractor's expense. Placement and compaction of the replacement material shall conform to the requirements contained herein.

8. The bottom of excavations shall be rendered firm and dry before placing any structure. Excavated material not suitable for backfill shall be removed from the site and disposed of by the Contractor.
9. Excavated material shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered.
10. All structure locations and elevations as required herein must be permanently documented by the Contractor, on the Record Drawings prior to the Engineer's approval of the Application for Payment for that work.
11. All pavements shall be cut prior to removal, with saws or approved power tools.
12. All trenches opened during the day shall be closed at the end of the workday.

3.05

SURVEY CONTROL

- A. The Contractor shall survey the location and elevation of the excavation. He shall also survey the location and elevation of the subgrade shown on the Drawings.
- B. The Contractor shall provide Record Drawings of the location and elevation of the excavation. The Contractor shall submit Record Drawings to the Owner's Representative at least 48 hours prior to the start of fill placement. The Contractor may submit partial Record Drawings to obtain approval for a portion of work.

3.06

DRAINAGE AND DEWATERING

- A. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavations, and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade foundation condition or structure subgrade foundation condition. The dewatering method used shall prevent disturbance of earth below grade.
- B. All water pumped or drained from the excavated area shall be disposed of in a suitable manner without undue interference with other work, without damage to surrounding property, and in accordance with pertinent rules and regulations.
- C. No construction shall be allowed in water. Groundwater shall be maintained at least 36 inches below excavation. No water shall be allowed to come into contact with masonry or concrete within 24 hours after being placed. The Contractor shall constantly guard against damage due to water and take full responsibility for all damage resulting from his failure to do so.

- D. The Contractor will be required at his expense to excavate below grade and refill with approved fill material if the Owner determines that adequate drainage has not been provided.

3.07 UNDERCUT

- A. If the bottom of any excavation is below that shown on the Drawings or specified because of Contractor error, convenience, or unsuitable subgrade due the Contractor's excavation methods, refill to normal grade with fill at Contractor's cost. Fill material and compaction method shall be as directed by the Geotechnical Engineer.

3.08 STABILIZATION

- A. Subgrades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact.
- B. Subgrades for concrete structures which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel. The finished elevation of stabilized subgrades for concrete structures shall not be above subgrade elevations shown on the Drawings.
- C. All stabilization work shall be performed by and at the expense of the Contractor.

3.09 FILL AND COMPACTION

- A. Materials:
 - 1. To the maximum extent available, excess earth obtained from subgrade, structure, and trench excavation shall be used for the construction of fills and embankments if it meets the requirements of Paragraph 2.01 A and B.
 - 2. Materials used as backfill shall be free from rocks or stones in accordance with Paragraph 2.01 A & B; brush, stumps, logs, roots, debris, and organic or other deleterious materials; and must be acceptable to the Engineer.
- B. Placement and Compaction:
 - 1. Degree of compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557. The dry density and moisture content shall be measured in accordance with ASTM D 2922, Method B, and ASTM D 3017, respectively. The term "maximum density" shall mean the maximum density determined under ASTM D1557.
 - 2. Backfill materials shall be placed in approximately horizontal layers not to exceed 8 inches in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.
 - 3. Each layer of material being compacted shall have the best practicable uniform moisture content to ensure satisfactory compaction. The Contractor

will be required to add water and harrow, disc, blade, or otherwise work the material in each layer to ensure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted by rolling or other method acceptable to the Engineer to the percent of maximum density at optimum moisture content as described in Table 02220-A and as determined by ASTM D1557, (latest).

4. Whenever a trench passes through a backfill or embankment, material shall be placed and compacted to an elevation 12 inches above the top of the pipe before the trench is excavated.

- C. Compact and backfill excavations and construct embankments according to the schedule listed in Table 02220-A. Backfill schedule for pipes is listed in Table 02220-B. (ASTM D1557, (latest)). The minimum compaction Testing Frequency shall be as follows:

<u>Location</u>	<u>Frequency</u>
Buildings and structures	1 test group ^a for every 2,500 square feet
Building Column Footings	1 test group ^a for every location
Road	1 test group ^a for every 300 feet of road
Parking Lots	1 test group ^a for every 10,000 square feet
Unpaved areas	1 test group ^a for every 20,000 square feet

^a *One test group consists of compaction tests on each layer of fill and backfill material.*

- D. Excavations shall be backfilled to the original grade or as indicated on the Drawings. Deviation from this grade because of settling shall be corrected. Backfill operation shall be performed to comply with all rules and regulations and in such a manner that it does not create a nuisance or safety hazard.

Table 02220-A

COMPACTION AND BACKFILL SCHEDULE

Area	Material	Compaction
Perimeter road berms embankments	Granular Fill Materials (Para. 2.01 B)	8 inch lifts, compacted to 95% relative density. Fill should not be placed over any in-placed soils until those layers have been compacted to 95% relative density.
Beneath all structures, and foundations (minimum 2 foot depth)	Granular Fill Materials (Para. 2.01 B)	8 inch lifts, compacted to 95% relative density. Fill should not be placed over any in-placed soils until those layers have been compacted to 95% relative density.
Beneath pavements (minimum 2 foot depth and minimum distance of 2 feet outside the edge of pavement)	Granular Fill Materials (Para. 2.01 B)	8 inch lifts, compacted to 95% relative density. Fill should not be placed over any in-placed soils until those layers have been compacted to 95% relative density.
From cleared existing surface to subgrade for paved and gravel roadway surfaces	Granular Fill Materials (Para. 2.01 B)	12 inch lifts, compacted to 95% relative density.
Area	Material	Compaction
Gravel Base Fill under building floor slabs-on-grade	Coarse Aggregate (Para. 2.01 B)	75% relative density per ASTM D4253 and D4254
Disturbed area requiring sodding	Topsoil	See Section 02930

- E. Embankments shall be constructed true to lines, grades and cross sections shown on the plans or ordered by the Owner. Embankments shall be placed in successive layers of not more than 8 inches in thickness, loose measure, for the full width of the embankment. As far as practicable, traffic over the work during the construction phase shall be distributed so as to cover the maximum surface area of each layer.
- F. If the Contractor requests approval to backfill material utilizing lifts and/or methods other than those specified herein, such request shall be in writing to the Engineer.

Approval will be considered only after the Contractor has performed tests, at the Contractor's expense, to identify the material used and density achieved throughout the backfill area utilizing the method of backfill requested. The Engineer's approval will be in writing.

G. Foundation Preparation

1. The existing ground beneath structural foundations, tank base slabs equipment base slabs and slabs on grade shall be removed and the area proof-rolled. Proof-rolling the buildings and containment areas should consist of at least 10 passes of a self-propelled vibrator compactor capable of delivering a minimum impact force of 30,000 to 35,000 pounds per drum to the soils. Geotechnical Engineer shall recommend the type of compaction device, capability needs, and location relative to the structure. Each pass should overlap the preceding pass by 30 percent to insure complete coverage. Backfilled areas shall be compacted in 8-inch layers to a density of not less than the percent of relative compaction as described in Table 02220-A for a depth of not less than 2-feet below the bottom of the foundations or concrete slabs to be not less than that depth indicated in Table 02220-A. Any unsuitable foundation material that continues to "yield" shall be removed and replaced with suitable material.
2. Slabs On Grade: Subgrades for concrete slabs shall be removed, backfilled, and compacted to the required grade. The top 2-feet of concrete slab subgrade in cut sections and all fill material shall be compacted in 8-inch layers to a density of not less than the percent of relative compaction as described in Table 02220-A.

3.10 FINAL GRADING

- A. After other outside work has been finished, and backfilling completed and settled, all areas on the site of the work which are to be graded shall be brought to grade with the tolerance of +0.1 feet at the indicated elevations, slopes, and contours where seeding or sodding is not required or, where sodding is required within two (2) inches of finished grade. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to hand work. All surfaces shall be graded to secure effective drainage. Unless otherwise shown, a slope of at least one percent shall be provided.
- B. After grading and where grassing is required, topsoil shall be evenly spread to a minimum depth of six (6) inches. Topsoil shall be from an Engineer approved source and shall be clear of trash, debris and surface vegetation more than six (6) inches in height.
- C. Grading and surfacing shall be completed to the satisfaction of the Engineer.

3.11 EXCESS EXCAVATED MATERIALS

- A. Insofar as needed, suitable excavated materials shall be used in fills and embankments shown on the Drawings. All suitable excess excavated material shall be placed at the stockpile area shown on the Drawings or designated by the County.
- B. The Contractor shall segregate different types of excavated materials (i.e. sands, clayey sands, clay) in the stockpile area. All debris, junk, stones, logs, stumps, roots, and other unsuitable materials may be disposed of by the Contractor in the landfill, but first must be weighed on the truck scales.
- C. The Contractor should slope and compact the stockpile with a light roller type vehicle to maintain stability.
- D. The Contractor shall maintain proper soil and erosion control measures.

3.12 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the General Conditions.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer or Owner.

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

SECTION 02514

PORTLAND CEMENT CONCRETE PAVING

PART 1 — GENERAL

1.01 WORK INCLUDED

- A. Concrete Curb And Gutter
- B. Concrete Sidewalks
- C. Concrete Driveways
- D. Reinforcement
- E. Surface Finish
- F. Curing

1.02 RELATED WORK

- A. Section 02200 — Excavation and Backfill
- B. Section 02510 — Bituminous Paving

1.03 REFERENCES

- A. ACI 301 Specifications for Structural Concrete for Buildings
- B. ANSI/ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement
- C. ANSI/ASTM A497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- D. ANSI/ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
- E. ANSI/ASTM D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
- F. ASTM A615 Deformed and Plain Billet-Steel for Concrete Reinforcement
- G. ASTM C33 Concrete Aggregates
- H. ASTM C94 Ready Mixed Concrete

- | | | |
|----|-----------|---|
| I. | ASTM C150 | Portland Cement |
| J. | ASTM C260 | Air-Entraining Admixtures for Concrete |
| K. | ASTM C309 | Liquid Membrane-Forming Compounds for Curing Concrete |
| L. | ASTM C494 | Chemical Admixtures for Concrete |

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Obtain materials from same source throughout.

1.05 TESTS

- A. Testing and analysis shall be performed under provisions of Section 01410.
- B. The Contractor shall submit proposed mix design to Engineer for review prior to commencement of work.
- C. Testing firm shall take cylinders and perform slump tests in accordance with ACI 301.
- D. Tests of cement and aggregates shall be performed to ensure conformance with requirements stated herein.
- E. Four concrete test cylinders shall be taken for every 100 or less cubic yards of concrete placed each day.
- F. One additional test cylinder shall be taken during cold weather and be cured on site under same conditions as concrete it represents.
- G. One slump test shall be taken for each set of test cylinders taken.

1.06 SUBMITTALS

- A. Submit product data under provisions of Section 01340 of the General Requirements.
- B. Include data on admixtures and curing compounds.
- C. Submit manufacturer's instructions under provisions of Section 01340 of the General Requirements.

PART 2 — PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cement shall conform to the latest revised Standard Specification for Portland cement, American Society for Testing and Materials, (ASTM) C150, or Standard Specification for Blended Hydraulic Cements, ASTM C595.
- B. Cement shall correspond to that cement on which the selection of concrete proportions was based.
- C. Concrete aggregates shall conform to the latest revised Standard Specifications for Concrete Aggregates, ASTM C33. Maximum coarse aggregate size shall be not more than 1/4 the slab thickness.
- D. All mixing water shall be clean and free from deleterious amounts of acids, alkalies, or organic materials.

2.02 FORM MATERIALS

- A. Shall conform to ACI 301.
- B. Shall be wood or steel form material, profiled to suit conditions.
- C. Expansion joints where required shall be 3/4in. thick redwood.

2.03 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615; 60 yield grade; deformed billet steel bars, uncoated finish.
- B. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; in flat sheets; uncoated finish.
- C. Tie Wire: Annealed steel, minimum 16 gage size.
- D. Dowels: ASTM A615; 40 ksi yield grade, plain steel, uncoated finish.

2.04 ADMIXTURES AND CURING COMPOUND

- A. Air entraining admixtures for concrete shall conform to the latest revised Standard Specifications for Air—Entraining Admixtures for Concrete, ASTM C260.
- B. Curing compound shall conform to the latest revised Standard Specifications for Liquid Membrane—Forming Compounds for Curing Concrete, ASTM C309.

2.05 CONCRETE MIX

- A. The Contractor shall mix concrete in accordance with ASTM C94.
- B. The Contractor shall select proportions for normal weight concrete in accordance with ACI 301.
- C. The Contractor shall provide concrete to the following criteria:

<i>Unit</i>	<i>Measurement</i>
Compressive Strength at 28 days	3000 psi
Slump (maximum)	2–5in.
Aggregate Size (maximum)	1in.
Cement Content (minimum)	545 lbs. per cubic yard
Water (maximum)	6 gallons/Bag of Cement

- D. The Contractor shall use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.
- E. The Contractor shall use set-retarding admixtures during hot weather only when approved by the Engineer.
- F. The Contractor shall add air entraining agent to concrete mix for concrete work exposed to exterior.

PART 3 — EXECUTION

3.01 INSPECTION

- A. The Contractor shall verify compacted granular base is ready to support paving and imposed loads.
- B. The Contractor shall verify gradients and elevations of base are correct.
- C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

- A. The Contractor shall moisten base to minimize absorption of water from fresh concrete.
- B. The Contractor shall notify the Engineer a minimum 24 hours prior to commencement of concreting operations.

3.03 FORMING

- A. Place and secure forms to correct location, dimension, and profile.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

3.04 REINFORCEMENT

- A. Place reinforcement as shown on Contract Drawings.
- B. Place reinforcement to achieve slab alignment as detailed.
- C. Provide dowelled joints as shown on Contract Drawings.

3.05 FORMED JOINTS

- A. Place expansion and control joints as shown in Contract Drawings to correct elevation and profile. Align curb, gutter, drive, and sidewalk joints.
- B. Place joint filler between paving components and building or other appurtenances.

3.06 PLACING CONCRETE

- A. The Contractor shall place concrete in accordance with ACI 301.
- B. Hot Weather Placement: ACI 301.
- C. Cold Weather Placement: ACI 301.
- D. The Contractor shall ensure reinforcement, inserts, embedded parts, formed joint fillers, and joint devices are not disturbed during concrete placement.
- E. The Contractor shall place concrete continuously between predetermined construction joints. He shall not break or interrupt successive pours such that cold joints occur.
- F. The Contractor shall notify Engineer a minimum 24 hours prior to commencement of operations.

3.07 FINISHING

- A. Paving: Light broom.
- B. Curbs and Gutters: Light broom.

- C. The Contractor shall place curing compound on exposed concrete surfaces immediately after finishing. He shall apply in accordance with manufacturer's instructions.

3.08 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01410.
- B. The Contractor shall maintain records of placed concrete items. He shall record date, location of pour, quantity, air temperature, and test samples taken.

3.09 PROTECTION

- A. Immediately after placement, the Contractor shall protect concrete from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. The pavement shall be closed to passenger car traffic for at least 7 full days or until such time that the minimum compressive strength of the concrete is at least 75% of its design strength. Traffic shall be restricted to passenger cars and light trucks for at least 14 days after concrete is placed. In all cases approval shall be obtained prior to opening of the pavement to traffic.

**** END OF SECTION ****

SECTION 02529
CONCRETE SIDEWALK

PART 1- GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Concrete sidewalk.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 1 - General Requirements.
 - 2. Section 03308 - Concrete, Materials and Proportioning,
 - 3. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing,
 - 4. Section 03350 - Testing.

1.02 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M 148, Liquid Membrane-Forming Compounds for Curing Concrete.
 - b. M 153, Standard Specifications for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - c. M 171, Sheet Materials for Curing Concrete.
 - d. M182, Burlap Cloth Made From Jute or Kenaf.
 - e. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction.
 - 2. American Concrete Institute (ACI):
 - a. 211, Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - b. 214, Recommended Practice for Evaluation of Strength Test Results of Concrete.
 - c. Refer to Sections 03308, 03311 and 03350 for additional standards.
 - 3. American Society for Testing and Materials (ASTM):
 - a. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement,
 - b. C227, Standard Test Methods for Potential Alkali Reaction.
 - c. C289, Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method),

- d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- e. D1140, Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75-Micrometer) Sieve.
- f. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft²(2,700 kN-m/m²)).
- 4. Federal Specification (FS):
 - a. SS-S-164.
 - b. TT-S 00227 E (3), Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glaring in Buildings and Other Structures.
- 5. National Ready Mixed Concrete Association (NRMCA).
- 6. Plant Manufacturer's Bureau of NRMCA.

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. See General Requirements.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 3. Mix design in accordance with Sections 03308 and 03350.
 - 4. Qualifications of concrete installer.
 - 5. Concrete cylinder test results from field quality control.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Chemical admixtures:
 - a. Sika Chemical Corporation.
 - b. Master Builders Company,
 - c. Protex Industries.
 - d. W.R.Grace and Company.
 - e. Or approved equal.
- B. Submit requests for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

- A. Portland Cement:

1. ASTM 0150, Type I or II.
- B. Aggregates:
 1. ASTM C33, gradation size #67, 3/4 IN to #4.
- C. Water:
 1. Potable quality.
- D. Admixtures:
 1. Comply with Section 03308.
- E. Welded Wire Fabric
 1. ASTM A I 85.
 2. Flat.
 3. Clean, free from dirt, scale, and rust.
- F. Preformed Joint Filler:
 1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
 2. Meet AASHTO M153 Or M213.
- G. Hot-Poured Joint Sealing Material:
 1. Fad Spec SS-S-164. I
- H. Sidewalk Joint Sealant:
 1. Two compound, polyurethane sealant.
 2. Class A, Type 1.
 3. Self-leveling.
 4. Nontracking.
 5. Fed Spec TT-S 00227 E (3).
- I. Membrane Curing Compound:
 1. ASTM C309.
- J. Cover Materials for Curing:
 1. Burlap:
 - a. ASSHTO M 182,
 - b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
 2. Polyethylene film:
 - a. AASHTO M 171.
- K. Forms:
 1. Steel or wood.

2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment. Free of distortion and defects.
4. Full depth.
5. Metal Side Forms:
 - a. Minimum 7/32 IN thick.
 - b. Depth equal to edge thickness of concrete.
 - c. Flat or rounded top minimum 1-3/4 IN wide.
 - d. Base 8 IN wide or equal to height, whichever is less.
 - e. Maximum deflection 1/8 IN under center load of 1700 LBS.
 - f. Use flexible spring steel forms or laminated boards to form radius bends.

2.03 MIXES

- A. Mix design to provide 4,000 psi 28-day compressive strength, 1-1/2 IN \pm 1 IN slump, 6 percent air.
- B. Comply with Sections 03308 and 03311.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Subgrade Preparation:
 1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
 2. Assure moisture content is within limits prescribed to achieve required compaction density.

3.02 INSTALLATION

- A. Concrete Production:
 1. Comply with Section 03311.
- B. Forms:
 1. Form support: a. Compact soil foundation and cut to grade to support forms. b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
 - a. Do not use earth pedestals.
 2. Staking forms:
 - a. Joint forms neatly and tightly,
 - b. Stake and pin securely with at least three pins for each 10 FT section.
 3. Clean and oil forms prior to placement of concrete.

4. Set forms sufficiently in advance of work (minimum 2 HRS) to permit proper inspection.
 5. Previously finished pavement or curb and gutter contiguous with new work may serve as side form when specifically approved.
- C. Reinforcing:
1. Lap mats one full space.
 2. Tie end transverse member of upper mat securely to prevent curling.
 3. Lap non-welded bars 12 IN minimum.
 4. Support: a. Place bars securely on chairs at called-for height. b. Place other fabric on the first of a two-course pour and save promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.
- D. Joints:
1. Hold locations and alignment to within $\pm 1/4$ IN.
 2. Finish concrete surface adjacent to previous section to within $\pm 1/8$ IN, with tooled radius of 1 1/4 IN.
 3. Metal keyway joints:
 - a. Form by installing metal joint strip, left in place.
 - b. Stake and support like side form.
 - c. Provide dowels or tie bars.
 4. Concrete walk control joints:
 - a. Locate at 8-foot intervals maximum. See Drawings.
 - b. Tool groove in freshly placed concrete with foaling device.
 - c. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
 5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
 6. Expansion joints:
 - a. Locate at 48 FT intervals and at all intersection curb returns,
 - b. Stake in place load transfer device consisting of dowels.
 - c. Supporting and spacing means and premolded joint filler as per Drawing details.
 - d. Provide preformed joint filler at all junctions with existing sidewalks, steps, or other structures.
 7. Thoroughly clean and fill joints with joint sealing material as specified.
 8. Upper surface of filled joint to be flush to 1/8 IN below finish surface.
- E. Place Concrete:

1. Comply with Section 03311.
 2. Construct driveway openings and other features as per Drawing details.
- F. Cold and Hot Weather Concreting:
1. Cold weather:
 - a. Cease concrete placing when descending air temperature in shade falls below 40 Deg F.
 - b. Do not resume until ambient temperature has risen to 40 Deg F.
 - c. If placing is authorized below 40 DegF by Engineer, maintain temperature of mix between 60 and 80 DegF. d. Heat aggregates or water or both. e. Water temperature may not exceed 175 DegF. f. Aggregate temperature may not exceed 150 DegF. g. Remove and replace frost-damaged concrete. h. Salt or other antifreeze is not permitted.
 - d. Comply with ACI 306.
 2. Hot weather:
 - a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DegF.
 - b. Aggregates or water or both may be cooled.
 - c. Cool water with crushed ice.
 - d. Cool aggregates by evaporation or water spray.
 - e. Never batch cement hotter than 160 DegF.
 - f. Comply with ACI 305.
- G. Finishing:
1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
 2. Maintain uniform ridge full width with first pass of first screed.
 3. Test with 6 FT straightedges equipped with long handles and operated from sidewalk.
 4. Draw excess water and laitance off from surface.
 5. Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.
 6. Broom finish after floating.
 7. Tool edges with suitable edger.
- H. Curing:

1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a rate of minimum 200 SF per gallon.
 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
 3. Cure for minimum of 7 days.
 4. When average daily temperature is below 50 DegF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
- I. Protection of Concrete:
1. Protect new sidewalk, steps, and their appurtenances from traffic for a minimum of 14 days.
 2. Repair or replace parts of sidewalk and steps damaged by traffic, or other causes, prior to final acceptance.
- J. Opening to Traffic:
1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured cylinders have attained a compressive strength of 3000 LBS per square inch when tested in accordance with ASTM standard methods.
 2. Prior to opening to traffic, clean and refill joints as required with specified filler material.
- K. Clean Up:
1. Assure clean-up work is completed within 2 weeks after sidewalk has been opened to traffic.
 2. No new work will begin until clean-up work has been completed, or is maintained within 2 weeks after sidewalk has been opened to traffic.

3.03 FIELD QUALITY CONTROL

- A. Provide test cylinders in accordance with Section 03350 for each 10 CY of placed concrete.

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

SECTION 02612
CONCRETE PIPE

PART 1 — GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required for reinforced concrete pipe.
- B. The extent of piping is shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02140 — Dewatering (During Construction)
- C. Section 02200 — Excavation and Backfill

1.03 REFERENCE STANDARDS

- A. ASTM C 76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- A. ASTM C 443 Joints for Circular Concrete Sewer and Culvert Pipe, with Rubber Gaskets
- B. ASTM C 506 Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
- C. Federal Specification SS-S-210A

1.04 QUALITY CONTROL

A. Source Quality

- 1. Contractor shall obtain each type of pipe and fittings from only one manufacturer.
- 2. The Contractor shall move no concrete pipe or fittings from the casting yard until such pipe or fittings have been cured a minimum of 7 days for pipe 18in. to 27in. in diameter and 14 days for pipe 30in. in diameter or larger.
- 3. Special fittings shall be produced by the pipe manufacturer to comply with all respects to the applicable requirements of the specifications.
- 4. The interior of all pipe shall have true section complying with the internal size(s) specified. All pipe shall be free from fins, bulges, ridges, offsets, projections, defects, or roughness of any kind.

5. Pipe rejected by the Engineer shall be removed from the site.
- B. Inspection: Raw materials, manufacturing processes, and finished concrete piping products are subject to review by the Engineer at the manufacturer's plant.

1.05 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit detailed drawings and data on pipe, fittings, gaskets, laying schedule, and appurtenances in accordance with Section 01340.
- B. Certificates: The Contractor shall submit certificates of compliance with referenced standards.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

The Contractor shall comply with the requirements of Section 01600.

PART 2 — PRODUCTS

2.01 CONSTRUCTION AND MATERIALS

- A. Pipe and Fittings Standard:
 1. Round Pipe: ASTM C 76, Class III
 2. Arch Pipe: ASTM C 506, Class A-III
- B. Pipe Lengths and Ends: Pipe length shall be a minimum 8ft. laying length except at manhole or storm drain closures and pipe ends shall be normal to the walls and center of pipe.
- C. Joints: Round Pipe
 1. Joints shall be tongue and groove or bell and spigot design to provide continuous line of pipe with a smooth interior free from irregularities in the flow line.
 2. Joints shall utilize a profile rubber gasket or a combination of “O” ring rubber gasket and preformed mastic sealant for sealing.
 3. Profile gasket and “O” ring gasket material shall meet requirements of ASTM C 443, latest edition.

D. Joints: Arch Pipe

1. Joints shall be tongue and groove type design to provide continuous line of pipe with a smooth interior free from irregularities in the flow line.
2. Joints shall utilize preformed flexible mastic conforming to Federal Specification SS-S-210A.

2.02 IDENTIFICATION

- A. The Contractor shall clearly mark all items furnished under this section with waterproof paint, or as otherwise approved by the Engineer, to include the following information:
1. Manufacturer's name or trademark
 2. Pipe class
 3. Specification designation
 4. Size
 5. Length
 6. Date and place of manufacture
- B. Mark pipe 24in. and larger on exterior and interior.

PART 3 — EXECUTION

3.01 INSTALLATION

- A. Pipe shall be installed in accordance with Section 02200 of these specifications.
- B. Joints shall be sealed with gasket material installed in accordance with the manufacturer's recommendation.
- C. Backfilling of pipe may proceed as soon as the pipe has been coupled. Precautions shall be taken in placing and compacting backfill to avoid damage to the joints.

**** END OF SECTION ****

SECTION 02930

SEEDING, SODDING, SPRIGGING, AND MULCHING

PART 1 — GENERAL

1.01 SCOPE

The work shall consist of preparing the area for treatment, furnishing and placing seed, sod, sprigs, mulch, fertilizer, inoculant, lime, and other soil amendments, and anchoring mulch in designated areas as specified.

1.02 RELATED PROVISIONS SPECIFIED ELSEWHERE

Section 02218 — Landscape Grading

Section 02270 — Slope Protection and Erosion Control

Section 02920 — Ditch Liner

PART 2 — PRODUCTS

2.01 MATERIALS

Seed: All seed shall conform to the current rules and regulations of the state where it is being used and shall be from the latest crop available. It shall meet or exceed the standard for purity and germination listed in Part 3.06.

Seed shall be labeled in accordance with the state laws and the U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of invitations for bids. Bag tag figures will be evidence of purity and germination. No seed will be accepted with a test date of more than 9 months prior to the delivery date to the site.

Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be accepted. The percent of noxious weed seed allowable shall be as defined in the current state laws relating to agricultural seeds. Each type of seed shall be delivered in separate sealed containers and fully tagged unless exception is granted in writing by the Engineer.

Sod: Use only high-quality common Bermuda grass sod of known genetic origin, free of noxious weeds, disease, and insect problems. It should appear healthy and vigorous, and conform to the following specifications:

- A. Sod should be machine cut at a uniform depth of ~~1/2in.~~**2in.** (excluding shoot growth and thatch).
- B. Sod should not have been cut in excessively wet or dry weather.
- C. Sections of sod should be a standard size as determined by the supplier, uniform, and untorn.

- D. Sections of sod should be strong enough to support their own weight and retain their size and shape when lifted by one end.
- E. Harvest, delivery, and installation of sod should take place within a period of 36 hours.

Fertilizer: Unless otherwise specified, the fertilizer shall be a commercial grade fertilizer. The fertilizer shall meet the standard for grade and quality specified by state law. Where fertilizer is furnished from bulk storage, the Contractor shall furnish a supplier's certification of analysis and weight. When required by the contract, a representative sample of the fertilizer shall be furnished to the Engineer for chemical analysis.

Inoculants: The inoculant for treating legume seeds shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species and shall not be used later than the date indicated on the container or as otherwise specified. A mixing medium, as recommended by the manufacturer, shall be used to bond the inoculant to the seed. Two times the amount of the inoculant recommended by the manufacturer shall be used, except four times the amount shall be used when seed is applied by use of a hydraulic seeder. Seed shall be sown within 24 hours of treatment and shall not remain in the hydraulic seeder longer than 4 hours.

Lime and other Soil Amendments: Lime shall consist of Standard Ground Agriculture Limestone, or approved equivalent. Standard Ground Agriculture Limestone is defined as ground limestone meeting current requirements of the State Department of Agriculture.

Mulch Tackifiers: Asphalt emulsion tackifiers shall conform to the requirements of ASTM D 977, Specification for Emulsified Asphalt. The emulsified asphalt may be rapid setting, medium setting, or slow setting. Non-asphaltic tackifiers required because of environmental considerations shall be as specified in Section 8.

Straw Mulch Materials: Straw mulch shall consist of wheat, barley, oat or rye straw, hay, grass cut from native grasses or other plants as specified in Part 3.06. The mulch material shall be air dry, reasonably light in color, and shall not be musty, moldy, caked, or otherwise of low quality. The use of mulch that contains noxious weeds will not be permitted. The Contractor shall provide a method satisfactory to the Engineer for determining weight of mulch furnished.

Other Mulch Materials: Mulching materials, such as wood cellulose fiber mulch, mulch tackifiers, synthetic fiber mulch, netting, and mesh are other mulching materials that may be required for specialized locations and conditions. These materials, when specified, must be accompanied by the manufacturer's recommendations for methods of application.

PART 3 — EXECUTION

3.01 SEEDING MIXTURES, SOD, SPRIGS, AND DATES OF PLANTING

The application rate per acre for seed mixtures, sprigs, or sod and date of seeding or planting shall be as shown on the plans or as specified in Part 3.06.

3.02 SEEDBED PREPARATION AND TREATMENT

Areas to be treated shall be dressed to a smooth, firm surface. On sites where equipment can operate on slopes safely, the seedbed shall be adequately loosened ~~4in.~~**6in.** and smoothed. Depending on soil and moisture conditions, disking or cultipacking or both may be necessary to properly prepare a seedbed. On sites where equipment cannot operate safely, the seedbed shall be

prepared by hand methods by scarifying to provide a roughened soil surface so that broadcast seed will remain in place.

If seeding is to be accomplished immediately following construction operations, seedbed preparation may not be required except on compacted, polished, or on freshly cut soil surfaces.

Rocks larger than **6in.** in diameter, trash, weeds, and other debris that will interfere with seeding or maintenance operations shall be removed or disposed of. Seedbed preparation shall be discontinued when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed as determined by the Engineer.

3.03 SOIL PREPARATION FOR SOD INSTALLATION

Test soil to determine the exact requirements for lime and fertilizer. Soil tests may be conducted by the State soil testing lab or a reputable commercial laboratory. Information on soil testing is available from the Cooperative Extension Service. Where sodding must be planned without soil tests, the following soil amendments may be sufficient:

- A. Pulverized agricultural limestone at a rate of 2 tons/acre 9100 lb/1,000 ft²)
- B. Fertilizer at a rate of 600 lb/acre (15 lb/1,000 ft²) of 13-13-13.

Equivalent nutrients may be applied with other fertilizer formulations. These amendments should be spread evenly over the area and incorporated into the top **4in.-8in.** of soil by disking, harrowing, or other effective means. If topsoil is applied, follow specifications given in The Topsoiling BMP.

Prior to laying sod, clear the soil surface of trash, debris, roots, branches, stones, and clods larger than **2in.** in diameter. Fill or level low spots in order to avoid standing water. Rake or harrow the site to achieve a smooth and level final grade.

Complete soil preparation by rolling or cultipacking to firm the soil. Avoid using heavy equipment on the area, particularly when the soil is wet, as this may cause excessive compaction and make it difficult for the sod to take root.

3.04 SEEDING, SPRIGGING, FERTILIZING, MULCHING, AND STABILIZING

All seeding or sprigging operations shall be performed in such a manner that the seed and/or sprigs are applied in the specified quantities uniformly on the designated areas. The method and rate of seed application shall be as specified in Part 3.06. Unless otherwise specified, seeding or sprigging shall be accomplished within 2 days after final grading is completed and approved.

Fertilizer, lime, and other soil amendments shall be applied as specified in Part 3.06. When specified, the fertilizer and soil amendments shall be thoroughly incorporated into the soil immediately following surface application.

The rate, amount, and kind of mulching or mesh shall be as specified in Part 3.06. Mulches shall be applied uniformly to the designated areas, and shall be applied to areas seeded not later than 2 working days after seeding has been performed. Straw mulch material shall be stabilized within 24 hours of application by the use of a mulch crimper or equivalent anchoring tool or by a suitable tackifier. When the mulch crimper or equivalent anchoring tool is used, it shall have straight blades and be the type manufactured expressly for, and capable of firmly punching the mulch into the soil. On sites where the equipment can be safely operated, it shall be operated on

the contour. On sites where equipment cannot safely operate to perform the work required, hand methods shall be used.

The tackifier shall be applied uniformly over the mulch material at the specified rate, or by injecting it into the mulch material as it is being applied. The mesh or netting stabilizing materials shall be applied smoothly but loosely on the designated areas, and the edges shall be buried or securely anchored by means of spikes or staples.

The Contractor shall maintain the mesh or netting areas until all work under the contract has been completed and accepted. Maintenance shall consist of the repair of areas damaged by water erosion, wind, fire, or other causes. Such areas shall be repaired to re-establish the intended condition and to the design lines and grades required by the contract. The areas shall be re-fertilized, re-seeded, and re-mulched prior to the new application of the mesh or netting.

3.05 SOD INSTALLATION

Lay sod with strips butted tightly against each other. A sharpened mason's trowel can be used to tuck down the ends and trim pieces. Butting—angled ends caused by the automatic sod cutting must be matched correctly.

Roll sod immediately to achieve firm contact with the soil.

Water to a depth of **4in.** as soon as the sod is laid, and continue watering as needed.

Moistening the sod after it is unrolled helps maintain its viability. Store it in the shade during installation.

Rake the soil surface to break the crust just before laying the sod. During the summer, lightly irrigate the soil immediately before laying the sod to cool the soil and reduce root burning and dieback.

Do not sod on gravel or soils that have been treated recently with sterilants or herbicides.

Lay the first row of strip sod in a straight line with subsequent rows placed parallel to and **3ft.** from each other. Stagger strips in a brick-like pattern. Be sure that the sod is not stretched or overlapped and that all joints are butted tightly to prevent voids. Use a knife or sharp spade to trim and fit irregularly shaped areas.

Install strips of sod with their longest dimension perpendicular to the slope. On slopes 3:1 or greater, or wherever erosion may be a problem, secure sod with pegs or staples.

As sodding of clearly defined areas is completed, roll sod to provide firm contact between roots and soil.

After rolling, irrigate until the soil is wet **4in.** below the sod.

Keep sodded areas moist to a depth of **4in.** until the grass takes root. This can be determined by gently tugging on the sod — resistance indicates that rooting has occurred.

3.06 ITEMS OF WORK AND CONSTRUCTION DETAILS

Items of work to be performed in conformance with this specification and the construction details therefor are:

Item — Seeding

This item shall consist of the seedbed preparation and furnishing and applying seed, fertilizer, and lime on the disturbed areas within the work limits flatter than an 8:1 slope.

Item — Seeding and Mulching

This item shall consist of the seedbed preparation and furnishing and applying seed, fertilizer, lime, and mulch on the disturbed areas within the work limits no steeper than a 4:1 slope and no flatter than an 8:1 slope.

Item — Sodding Embankments

- A. This item shall consist of seedbed preparation and furnishing and placing sod on all disturbed areas of embankment of 4:1 slope or steeper.
- B. Seeding rates, application dates, and purity and germination standards shall be in accordance with the following table:

			Minimum Percent				
Seed	Rate/ Acre (lbs)	Application Date	Pure Seed	Germination	Pure Live Seed	Maximum Percent Weed Seed	Planting Depth
Rye	45	Sept 15 to Oct 31	90	90	88	2	¼in. to ½in.
White Clover (Trifolium repens)	3	Sept. 15 to Oct 31	98	85	83	.5	¼in. to ½in.
Common Bermuda — unhulled (Cynodon Dactylon)	15	Sept. 15 to Oct 31	97	85	82	1	¼in. to ½in.
Pensacola Bahagrass (Paspalum notatum)	30	Mar 1 to May 31	95	80	76	1	¼in. to ½in.
Common Bermuda — hulled (Cynodon Dactylon)	10	Mar 1 to May 31	97	85	82	1	¼in. to ½in.

- C. If within the application dates, protective cover shall be applied after final dressing of any cut and fill slopes has been completed. Otherwise, storm water pollution prevention practices shall be made and protective cover shall be applied during the next application dates.
- D. All seedbeds shall be dressed to a reasonably smooth surface to remove trenches, rills, or washes that may have developed. The fertilizer and lime shall be applied and incorporated into the seedbed approximately **3in.** by disking or harrowing. The fertilizer applied shall be a commercial grade fertilizer designated as 13-13-13 or its equivalent. It shall be applied at a rate of 800 pounds of 13-13-13 per acre. Agricultural lime shall be applied at the rate of 2 tons per acre.
- E. After the fertilizer has been applied and prior to planting, the seedbed shall be smoothed and scarified, if necessary, and the seeds shall be uniformly applied at the designated rate. Each seed species shall be uniformly applied in separate operations. After all seeding has been completed, a spike tooth harrow or other equipment shall be processed over the entire surface of the seedbed to cover the seed to the specified depth. A culti-packer or

roller shall be run over the seedbed to firm the seedbed area immediately following the covering of the seed.

- F Mulch shall be wheat or rice straw. It shall be applied on the same day that seeding is done. If a mulching machine is used to apply the mulch, baled mulch material shall be broken apart in sufficiently small pieces to prevent it from going through the mulching machine in chunks. The mulch will be anchored into the soil with a mulch crimper. The mulch crimping equipment shall have straight, notched, dull blades no more than **10in.** apart and shall be equipped with a scraper. The mulching material will be anchored **2in.–3in.** into the soil. Anchoring the mulch shall be performed along the contour of the ground surface. The Contractor shall control the amount of area seeded to allow the mulching to be completed in the same day. The mulch shall be applied evenly and uniformly over the areas at a rate of 1½ tons per acre.
- G. Plant establishment shall be considered acceptable when a satisfactory stand and growth of plantings have sufficiently covered the area seeded to provide erosion protection. Plant establishment shall consist of the necessary maintenance and repair of all seeded areas for the duration of the contract and warranty period. It shall include watering, mowing, repairing (filling and grading), seeding, fertilizing, liming, and mulching of areas damaged or eroded. Inspection of plant establishment shall be made by the Contractor and the Engineer on a quarterly (3-month) basis until final acceptance of the contract.

**** END OF SECTION ****

SECTION 03108 FORMWORK

PART 1- GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formwork requirements for concrete construction.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 347R, Guide to Formwork for Concrete.
- B. Qualifications:
 - 1. Formwork, shoring and reshoring to be designed by a professional structural engineer currently registered in the state where the Project is located and having a minimum of 3 years' experience in this type of design work.
- C. Miscellaneous:
 - 1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
 - 2. Design Requirements:
 - a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code. Where conflicts occur between the above two standards, the more stringent requirements shall govern.
 - b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.

1.3 DEFINITIONS

- A. Words and terms used in these Specifications are defined in ACI 116R.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer and type of proposed form materials.
 - d. Manufacturer and type of proposed form coating material.
 - 2. Formwork designer qualifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms for Surfaces Exposed to View:
 - 1. Wood forms:
 - a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
 - b. Built-in-place or prefabricated type panel.
 - c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire area.
 - d. When approved, plywood may be reused.
 - 2. Metal forms:
 - a. Metal forms excluding aluminum may be used.
 - b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
- B. Forms for Surfaces Not Exposed to View:
 - 1. Wood or metal sufficiently tight to prevent leakage. Do not use aluminum forms.

2.2 ACCESSORIES

- A. Form Ties:
 - 1. Commercially fabricated for use in form construction. Do not use wire ties.
 - 2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
 - 3. 3/4 IN minimum to 1 IN maximum diameter cones on both ends.
 - 4. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.

5. Provide ties with built-in waterstops in all cast-in-place manhole walls or other similar type walls that will be in contact with liquid or ground water below existing grade.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Form Surface Treatment:
 1. Before placing of either reinforcing steel or concrete, cover surfaces of forms with an approved coating material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
 2. Do not allow excess form coating material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
- B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.
- C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.2 ERECTION

- A. Install products in accordance with manufacturer's instructions.
- B. Tolerances:
 1. Variation from plumb:
 - a. In lines and surfaces of columns, piers, walls, and in risers.
 - 1) Maximum in any 10 FT of height: 1/4 IN.
 - 2) Maximum for entire height: 1/2 IN
 - b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
 - 1) Maximum in any 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
 2. Variation from level or from grades specified:
 - a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.

- 1) Maximum in any 10 FT of length: 1/4 IN.
 - 2) Maximum in any bay or in any 20 FT length: 3/8 IN.
 - 3) Maximum for entire length: 3/4 IN.
- b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
 - 1) Maximum in any bay or in 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
3. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
 - a. Maximum in any bay: 1/2 IN.
 - b. Maximum in any 20 FT of length: 1/2 IN.
 - c. Maximum for entire length: 1 IN.
4. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of $\pm 1/2$ IN.
5. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of $\pm 1/2$ IN.
6. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 IN, +1/2 IN.
7. Footings and foundations:
 - a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
 - b. Misplacement or eccentricity:
 - 1) 2 percent of footing width in direction of misplacement but not more than 2 IN.
 - c. Thickness:
 - 1) Decrease in specified thickness: 5 percent.
 - 2) Increase in specified thickness: No limit except that which may interfere with other construction.
8. Variation in steps:
 - a. In a flight of stairs:
 - 1) Rise: $\pm 1/8$ IN.
 - 2) Tread: $\pm 1/4$ IN.
 - b. In consecutive steps:
 - 1) Rise: $\pm 1/16$ IN.
 - 2) Tread: $\pm 1/8$ IN.

9. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
 10. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
 11. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.
- C. Make forms sufficiently tight to prevent loss of mortar from concrete.
 - D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled edges.
 - E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.
 - F. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.
 - G. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.
 - H. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.
 1. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation. Securely brace forms against lateral deflection. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

3.3 REMOVAL OF FORMS

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
- B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Section 03311.

- D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28-day compressive strength. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

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

SECTION 03208 REINFORCEMENT

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bar requirements for concrete construction.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. SP-66, ACI Detailing Manual.
 - b. 318, Building Code Requirements for Structural Concrete.
 - 2. American Society for Testing and Materials (ASTM):
 - a. A185, Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - b. A497, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
 - c. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement (Including Supplementary Requirements S1).
 - d. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - 3. American Welding Society (AWS):
 - a. D1.4, Structural Welding Code Reinforcing Steel.
 - 4. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
- B. Qualifications:
 - 1. Welding operators, processes and procedures to be qualified in accordance with AWS D1.4.
 - 2. Welding operators to have been qualified during the previous 12 months prior to commencement of welding.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:

- a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacture and type of proprietary rebar mechanical splices.
 - d. Manufacturer and type of rebar adhesive anchor including installation instructions.
 - 1) Include depth of embedment required to develop 125 percent of the yield strength of each bar size to be used on the Project.
- 2. Qualifications of welding operators, welding processes and procedures.
 - 3. Rebar number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and rebar supports.
 - 4. Sufficient rebar details to permit installation of reinforcing.
 - 5. Rebar details in accordance with ACI SP-66.
 - 6. Locations where proprietary rebar mechanical splices are required or proposed for use.
 - 7. Shop drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings. Shop drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Support and store all reinforcing above ground.
- B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the shop drawing mark numbers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

- A. Subject to compliance with Contract Documents, the following Manufacturers are acceptable:
 - 1. Rebar adhesive anchors:
 - a. HIT-HY150 adhesive cartridges by HILTI FASTENING SYSTEMS, INC.
 - b. Parabond capsules by MOLLY FASTENERS INC.
 - c. Needle capsules by Powers Fastening, Inc.
 - 2. Rebar mechanical splices:
 - a. Lenton Rebar Splicing by Erico, Inc.

- b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
 - c. Bar-Grip Systems by Barsplice Products, Inc.
- B. Submit requests for substitution in accordance with AGREEMENT.

2.2 MATERIALS

- A. Reinforcing Bars: ASTM A615, grade 60, deformed.
- C. Reinforcing Bars to be Welded: ASTM A706.
- D. Welded Wire Fabric: ASTM A185 or ASTM A497.
- E. Smooth Dowel Bars: ASTM A615, grade 60 with metal end cap to allow longitudinal movement equal to joint width plus 1 IN.
- F. Proprietary Rebar Mechanical Splices: To develop in tension and compression a minimum of 125 percent of the yield strength of the rebars being spliced.
- G. Welding Electrodes:
 - 1. E90 meeting requirements of AWS D1.4.
- H. Rebar Adhesive Anchors:
 - 1. Manufactured for the specific purpose of embedding and developing 125 percent of the yield strength of rebars in hardened concrete.

2.3 ACCESSORIES

- A. Metal Chairs, Runners, Bolsters, Spacers, Hangers, and Other Rebar Supports:
 - 1. Plastic-coated tips in contact with forms.
 - 2. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
- B. Protective plastic caps at mechanical splices.

2.4 FABRICATION

- A. Tolerances:
 - 1. Sheared lengths: ± 1 IN.
 - 2. Overall dimensions of stirrups, ties and spirals: $\pm 1/2$ IN.
 - 3. All other bends: $+0$ IN, $-1/2$ IN.
- B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 318 paragraph 7.2.
- C. Ship rebars to jobsite with attached plastic or metal tags.
 - a. Place on each tag the mark number of the rebar corresponding to the mark number indicated on the shop drawing.
 - 2. Mark numbers on tags to be so placed that the numbers cannot be removed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Tolerances:
1. Rebar placement:
 - a. Clear distance to formed surfaces: $\pm 1/4$ IN.
 - b. Minimum spacing between bars: $-1/4$ IN.
 - c. Top bars in slabs and beams:
 - 1) Members 8 IN deep or less: $\pm 1/4$ IN.
 - 2) Members between 8 IN and 2 FT deep: $-1/4$ IN, $+1/2$ IN.
 - 3) Members more than 2 FT deep: $-1/4$ IN, $+1$ IN.
 - d. Crosswise of members: Spaced evenly within ± 1 IN.
 - e. Lengthwise of members: ± 2 IN.
 2. Minimum clear distances between rebars:
 - a. Beams, walls and slabs: Distance equal to rebar diameter or 1 IN, whichever is greater.
 - b. Columns: Distance equal to 1-1/2 times the rebar diameter or 1-1/2 IN, whichever is greater.
 - c. Beam and slab rebars shall be threaded through the column vertical rebars without displacing the column vertical rebars and still maintaining the clear distances required for the beam and slab rebars.
- B. Minimum concrete protective covering for reinforcement: As shown on Drawings.
- C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
1. For rebars: Class B splice meeting the requirements of paragraph 12.15 of ACI 318.
 2. For welded wire fabric: Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than 1 spacing of cross wires plus 2 IN, nor less than 1.5 x development length nor less than 6 IN. Development length shall be as required for the yield strength of the welded wire fabric in accordance with Paragraph 12.8 of ACI 318.
 3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.
- D. Welding:
1. Obtain approval by the Engineer prior to welding reinforcing.
 2. Perform welding of rebars in accordance with requirements of AWS D1.4.
 3. Have each welder place an approved identifying mark near each completed weld.
- E. Placing Rebars:

- a. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.
- b. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the rebar supplied.
- c. Rebar support:
 - a. Uncoated rebar:
 - 1) Support rebars and fasten together to prevent displacement by construction loads or placing of concrete.
 - 2) On ground, provide supporting concrete blocks or metal bar supports with bottom plate.
 - a) Do not use concrete blocks to support slab-on-grade reinforcing.
 - 3) Over formwork, provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other rebar support. Only tips in contact with the forms need to be plastic coated.
- 4. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 IN. Place spacer rebars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.
- 5. Extend reinforcement to within 2 IN of concrete perimeter edges. If perimeter edge is formed by earth, extend reinforcement to within 3 IN of the edge.
- 6. To assure proper placement, furnish templates for all column vertical bars and dowels.
- 7. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer. Do not bend reinforcing by means of heat.
- 8. Do not tack weld reinforcing.
- 9. Embed rebars into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation.
 - a. Drill hole in concrete with diameter and depth as required to develop 125 percent of the yield strength of the bar according to manufacturer's requirements.
 - b. Place adhesive in drilled hole.
 - c. Insert rebar into hole and adhesive in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

- A. Reinforcement Congestion and Interferences:
1. Notify Engineer whenever the specified clearances between rebars cannot be met.
 2. Do not place any concrete until the Engineer submits a solution to rebar congestion problem.
 3. Rebars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
 4. If rebars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of rebars.
 5. No cutting of rebars shall be done without written approval of Engineer.
- B. Employ a testing laboratory to perform and report following:
1. Review and approve Contractor proposed welding procedures and processes for conformance with AWS D1.4.
 2. Qualify welders in accord with AWS D1.4.
 3. Test three samples of each bar size and each type of weld in accord with AWS D1.4. The tensile strength of each test shall be not less than 125 percent of the required yield strength of the rebar tested.
 4. Conduct nondestructive field tests (radiographic or magnetic particle) on not less than one random sample for each 10 welds. In addition if any welds are found defective, test five previous welds performed by same welder.
 5. Visually inspect each weld for presence of cracks, undercuts, inadequate size and other visible defects.
 6. Testing and inspection required for:
 - a. Anchor plates with rebars at rigid frame piers in the Transfer Station.
 7. Test rebar adhesive anchors and adhesive anchor bolts if required.

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

SECTION 03311
CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mixing, placing, jointing, and curing of concrete construction.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03108 - Formwork.
 - 4. Section 03208 - Reinforcement.
 - 5. Section 03348 - Concrete Finishing and Repair of Surface Defects.
 - 6. Section 03350 - Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - c. 304.2R, Placing Concrete by Pumping Methods.
 - d. 305R, Hot Weather Concreting.
 - e. 306R, Cold Weather Concreting.
 - f. 308, Standard. Practice for Curing Concrete.
 - g. 309R, Guide for Consolidation of Concrete.
 - 2. American Society for Testing and Materials (ASTM):
 - a. C94, Standard Specification for Ready-Mixed Concrete.
 - b. C171, Standard Specification for Sheet Materials for Curing Concrete.
 - c. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - d. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - e. D1056, Standard Specification for Flexible Cellular Materials Sponge or Expanded Rubber.

- f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete, Paving and Structural Construction, (Non-Extruding and Resilient Bituminous Types).
 - 3. National Ready Mixed Concrete Association (NRMCA):
 - a. Check List for Certification of Ready Mixed Concrete Production Facilities.
- B. Qualifications:
 - 1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.

1.3 DEFINITIONS

- A. Words and terms used in this Specification are defined in ACI 116R.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 1) Procedure for adding high-range water reducer at the jobsite.
 - c. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of construction joints and joint keyway dimensions.
 - d. Manufacturers and types:
 - 1) Joint fillers.
 - 2) Curing agents.
 - 3) Construction joint bonding adhesive.
 - 2. Certifications:
 - a. Ready mix concrete plant certification.
- B. Miscellaneous:
 - 1. Copies of concrete delivery tickets.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Delivery:
 - 1. Concrete:
 - a. Prepare a delivery ticket for each load of ready mixed concrete.
 - b. Truck operator shall hand ticket to Contractor at the time of delivery.
 - c. Ticket to show:
 - 1) Mix identification.

- 2) Quantity delivered.
- 3) Amount of material in each batch.
- 4) Outdoor temperature in the shade.
- 5) Time at which cement was added
- 6) Time of delivery.
- 7) Time of discharge.
- 8) Amount of water added.

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. Neoprene Expansion Joint Fillers:
 1. Manufacturers:
 - a. Permaglaze.
 - b. Rubatex.
 - c. Williams Products.
 2. Materials:
 - a. Closed cell neoprene.
 - b. ASTM D1056, Class SC, 2 to 5 psi compression deflection, Grade SCE-41.
- B. Asphalt Expansion Joint Fillers:
 1. Manufacturers:
 - a. W R Meadows.
 - b. J and P Petroleum Products.
 2. Materials: ASTM D994.
- C. Fiber Expansion Joint Fillers:
 1. Materials: ASTM D1751.
- D. Sand cement grout, non-shrink: grout and epoxy grout: See Section 03308.
- E. Membrane Curing Compound: ASTM C309, Type II or I-D:
 1. Coordinate type of membrane curing compound with floor finishes and with hot weather curing procedures.
 2. Curing compound shall not prevent bonding of any future coverings, coatings or finishes.
- F. Submit requests for substitutions in accordance with General Conditions.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:

1. Complete formwork.
 - a. See Section 03108.
2. Remove earth, snow, ice, water, and other foreign materials from areas that will receive concrete.
3. Secure reinforcement in place.
 - a. See Section 03208.
4. Position expansion joint material, anchors and other embedded items.
5. Obtain approval of reinforcement erection and placement prior to placing concrete.
6. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and approval is obtained.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and avoid unplanned cold joints.
 - b. Do not allow rainwater to increase mixing water nor to damage surface finish.
7. Coat all construction joints with an approved bonding material, before new concrete is placed. Apply proprietary bonding adhesive in accordance with manufacturer's instructions.
8. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
9. Provide slabs and beams of minimum indicated required depth when sloping structural foundation base slabs and elevated slabs to drains. For floor slabs on grade, slope top of subgrade to provide slab of required uniform thickness.

B. Preparation of Subgrade for Slabs On Ground:

1. Subgrade drained and of adequate and uniform load-bearing nature.
2. Obtain approval of subgrade compaction density prior to placing slabs on ground.
3. Maintain subgrade at a temperature above 32 DegF before concrete placing begins for a sufficient amount of time to remove frost.
4. Moisten subgrade to eliminate absorption. Keep subgrade moist at time of concreting. Allow no free-standing water on subgrade or soft or muddy spots when concrete is placed.

C. Edge Forms and Screeds:

1. Set accurately to produce designated elevations and contours of finished surface.

2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to contours of screed strips.

3.2 CONCRETE MIXING

A. General:

1. Provide all concrete from a central plant conforming to Check List for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.
2. Batch, mix, and transport in accordance with ASTM C94.

B. Control of Admixtures:

1. Charge admixtures into mixer as solutions.
 - a. Measure by means of an approved mechanical dispensing device.
 - b. Liquid considered a part of mixing water.
 - c. Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
2. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
3. Complete addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.

C. Tempering and Control of Mixing Water:

1. Mix concrete only in quantities for immediate use.
2. Discard concrete which has set.
3. Discharge concrete from ready mix trucks within time limit and drum revolutions stated in ASTM C94.
4. Addition of water at the jobsite:
 - a. See Section 03308 for specified water cement ratio and slump.
 - b. Do not exceed maximum specified water cement ratio or slump.
 - c. Incorporate water by additional mixing equal to at least half of total mixing required.
 - d. Perform strength test on any concrete to which water has been added at the jobsite. See Section 03350.

3.3 PLACING OF CONCRETE

A. General:

1. Comply with ACI 304R and 304.2R.

2. Deposit concrete:
 - a. Continuously to avoid cold joints.
 - b. In layers of 12 to 18 IN.
 3. Locate construction joints at locations approved by Engineer.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmosphere conditions to avoid unplanned cold joints.
 4. Place concrete at such a rate that concrete, which is being integrated with fresh concrete, is still workable.
 5. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
 6. Spreaders:
 - a. Temporary:
 - 1) Remove as soon as concrete placing renders their function unnecessary.
 - b. Embedded:
 - 1) Obtain approval of Engineer.
 - 2) Materials: Concrete or metal.
 - 3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
 7. Deposit concrete as nearly as practicable in its final position to avoid segregation.
 - a. Maximum free fall: 4 FT.
 - b. Free fall exceeding 4 FT:
 - 1) Place concrete by means of hopper, elephant trunk or tremie pipe extending down to within 4 FT of surface placed upon.
 8. Perform the following operations before bleeding water has an opportunity to collect on surface:
 - a. Spread.
 - b. Consolidate.
 - c. Straightedge.
 - d. Darby or bull float.
- B. High-Range Water Reducers (Superplasticizers):
1. Add superplasticizer to the concrete in the truck mixer at the jobsite.
 2. Perform concrete slump test at the jobsite both prior to and after addition of the admixture to the concrete.

C. Cold Weather Concrete Placement:

1. Comply with ACI 306R.
2. Do not place concrete on substrates that are below 32 DegF or contain frozen material.
3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
4. Temperature of concrete when discharged at site:

AIR TEMPERATURE (F)	MINIMUM CONCRETE TEMPERATURE,	MINIMUM CONCRETE TEMPERATURE,
	FOR SECTIONS WITH LEAST DIMENSION LESS THAN 12 IN	FOR SECTIONS WITH LEAST DIMENSION 12 IN OR GREATER
30 to 45	60	55
0 to 30	65	55
Below 0	70	60

5. Heat subgrade, forms, and reinforcement so the temperature of the subgrade, forms, and reinforcement will be between 45 and 70 DegF, when temperature of surrounding air is 40 DegF or below at time concrete is placed. Remove all frost from subgrade, forms and reinforcement before concrete is placed.
6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 DegF.
7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 DegF.
8. Do not place slabs on ground if temperature is below 40 DegF or if temperature surrounding the slab will be below 40 DegF before structure is enclosed and heated.

D. Hot Weather Concrete Placement:

1. Comply with ACI 305R.
2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
3. Temperature of concrete when placed:
 - a. Not to exceed 90 DegF.

- b. Not so high as to cause:
 - 1) Shrinkage cracks.
 - 2) Difficulty in placement due to loss of slump.
 - 3) Flash set.
 - 4. Temperature of forms and reinforcing when placing concrete:
 - a. Not to exceed 90 DegF.
 - b. May be reduced by spraying with water to cool below 90 DegF.
 - 1) Leave no standing water to contact concrete being placed.
- E. Consolidating:
 - 1. Consolidate in accordance with ACI 309R except as modified herein.
 - 2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
 - a. Eliminate:
 - 1) Air or stone pockets.
 - 2) Honeycombing or pitting.
 - 3) Planes of weakness.
 - 3. Internal vibrators:
 - a. Minimum frequency of 8000 vibrations per minute.
 - b. Insert and withdraw at points approximately 18 IN apart.
 - 1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
 - c. Use in:
 - 1) Beams and girders of framed slabs.
 - 2) Columns and walls.
 - d. Size of vibrators shall be in accordance with Table 5.1.5 of ACI 309R.
 - 4. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or other approved means.
 - 5. Do not use vibrators to transport concrete within forms.
 - 6. Provide spare vibrators on jobsite during all concrete placing operations.
 - 7. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.
 - 8. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.

9. Prevent construction equipment, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.
- F. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94.
 2. Horizontal belt conveyors:
 - a. Mount at a slope which will not cause segregation or loss of ingredients.
 - b. Protect concrete against undue drying or rise in temperature.
 - c. Use an arrangement at discharge end to prevent segregation.
 - d. Do not allow mortar to adhere to return length of belt.
 - e. Discharge conveyor runs into equipment specially designed for spreading concrete.
 3. Metal or metal lined chutes:
 - a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
 - b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
 - c. Provide end of each chute with a device to prevent segregation.
 4. Pumping or pneumatic conveying equipment:
 - a. Designed for concrete application and having adequate pumping capacity.
 - b. Control pneumatic placement so segregation is avoided in discharged concrete.
 - c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
 - d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
 - e. Provide pumping equipment without Y sections.

3.4 JOINTS AND EMBEDDED ITEMS

- A. General - Construction Joints:
1. Locate joints as indicated on Contract Drawings or as shown on approved shop drawings.

2. Unplanned construction joints will not be allowed. If concrete cannot be completely placed between planned construction joints, then it must be removed.
3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
 - a. At Contractor's option, beam pockets may be formed into concrete walls. Size pockets to allow beam reinforcing to be placed as detailed on Drawings.
5. Place beams and girders at same time as slabs.
6. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
7. Provide roughened construction joints at all construction joints at all wall horizontal and wall to slab construction joints unless indicated otherwise on Drawings.
 - a. Intentionally roughen the interface to a full amplitude of 1/4 IN.
 - b. Clean the previously hardened concrete interface and remove all laitance.
8. Provide continuous keyways at all wall vertical joints, slab construction joints and all construction joints not noted to be roughen construction joints. Construction joint keyways shall have the following dimensions, unless shown otherwise on Drawings or directed otherwise by Engineer.
 - a. Construction joint keyways in walls:
 - 1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
 - 2) Keyway depth to be not less than 1-1/2 IN.
 - 3) Place keyway in wall center unless shown otherwise on Drawings.
 - b. Construction joint keyways in footings, foundations, base slabs, and structural or elevated slabs:
 - 1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
 - 2) Keyway depth not less than 1-1/2 IN.
 - 3) Keyway in footing or slab center unless shown otherwise on Drawings.
 - c. Construction joint keyways in beams:
 - 1) Keyway height not less than 1/3 and not more than 1/2 the beam depth.

- 2) Keyway depth not less than 1-1/2 IN.
 - 3) Keyway in beam center unless shown otherwise on Drawings.
9. Allow a minimum of 48 HRS before placement of adjoining concrete construction.
- B. Construction Joints - Spacing:
 1. General - Structures not intended to contain liquid:
 - a. Wall vertical construction joints:
 - 1) 60 FT maximum centers.
 - 2) At wall intersections, 30 FT maximum from corner.
 - b. Wall horizontal construction joints: 20-25 FT centers.
 - c. Base slab, floor, and roof slab construction joints:
 - 1) Placements to be approximately square and not to exceed 3500 SF.
 - 2) Maximum side dimension of a slab pour to be 80 FT.
- C. Bonding at Construction Joints:
 1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened.
 - a. General - Use cement grout or dampening for all construction joints except as noted in paragraph 3.4-C.1 .b. below, or at Contractor's option use epoxy adhesive for all construction joints.
 - 1) Treatment of joint surface:
 - a) Roughen the surface of the concrete to expose the aggregate uniformly.
 - b) Remove laitance, loosened particles of aggregate or damaged concrete at the surface, or at the Contractor's option, use an approved chemical retarder which delays but does not prevent setting of the surface of the mortar in accordance with the manufacturer's recommendations. Retarded mortar shall be removed within 24 HRS after placing to produce a clean exposed aggregate bonding surface.
 - c) Dampen the hardened concrete (but do not saturate) immediately prior to placing of fresh concrete or grout.
 - 2) Cover the hardened concrete of horizontal joints with a coat of cement grout of similar proportions to the concrete, except substitute fine aggregate for coarse aggregate.

- a) Place 3 IN layer of grout in bottoms of wall or column lifts immediately before placing concrete. Vibrate grout and first layer of concrete simultaneously.
 - b) Place fresh concrete before the grout has attained its initial set.
- D. Locate control joints in slabs on grade as indicated on Drawings.
 - 1. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
 - a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw. Saw cuts to be completed during the same working shift that pours the slab-on-grade.
 - b. Complete before shrinkage stresses become sufficient to produce cracking.
- E. Expansion Joints:
 - 1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
 - 2. Use neoprene expansion joint fillers, unless noted otherwise on Drawings.
 - 3. Seal expansion joints as shown on Drawings. See Section 07900 for requirements.
- F. Embedded Items:
 - 1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
 - 2. Do not place electrical conduit, drains, or pipes in or thru concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.
- G. Placing Embedded Items:
 - 1. Position expansion joint material and other embedded items accurately.
 - 2. Support against displacement.
 - 3. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.

3.5 FINISHING

- A. See Section 03348.
 - 1. Coordinate mixing and placing with finishing.
- B. Slab finishes
 - 1. All interior building slabs on Ground Floor shall have a steel trowel finish

2. All interior building slabs on Second Floor shall have a steel trowel finish
3. All interior cast-in-place concrete stair treads and landings shall have broom finish
4. All exterior concrete vehicle apron slabs shall have broom finish
5. All exterior concrete sidewalks shall have broom finish
6. All exterior concrete equipment pads including bottled gas storage areas shall have light broom finish

3.6 INSTALLATION OF GROUT

A. Grout Schedule of Use:

1. Sand cement grout:
 - a. General use.
2. Non-shrinking non-metallic grout:
 - a. Filling form tie holes.
 - b. Under column and beam base plates.
 - c. Other uses indicated on the Drawings.
3. Epoxy grout:
 - a. Patching cavities in concrete deeper than 2 IN.
 - b. Grouting of dowels and anchor bolts into existing concrete.
 - c. Grouting of equipment base plates where driving motor is 500 HP and above.
 - d. Other uses indicated on the Drawings.

B. Grout Installation:

1. Sand cement grout:
 - a. Consolidate grout by rodding or by other means to assure complete filling of void.
 - b. Cure grout by one of methods specified.
2. Non-shrink non-metallic grout:
 - a. Clean concrete surface to receive grout.
 - b. Saturate concrete with water for 24 HRS prior to grouting.
 - c. Mix in a mechanical mixer.
 - d. Use no more water than necessary to produce flowable grout.
 - e. Place in accordance with manufacturer's instructions.
 - f. Provide under beam, column, and equipment base plates, and in other locations indicated on the Drawings.
 - g. Completely fill all spaces and cavities below the top of base plates.

- h. Provide forms where base plates and bed plates do not confine grout.
 - i. Where exposed to view, finish grout edges smooth.
 - j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate, bed plate, member or piece of equipment.
 - k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer.
- 3. Epoxy grout:
 - a. Mix and place in accordance with manufacturer's instructions.
 - b. Apply only to clean, dry, sound surface.
 - c. Completely fill all cavities and spaces around dowels and anchors without voids.
 - d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
 - e. Obtain manufacturer's field technical assistance as required to assure proper placement.

3.7

CURING AND PROTECTION

- A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain. Follow recommendations of ACI 308 except as modified herein.
- B. Apply one of the following curing procedures immediately after completion of placement and finishing, for concrete surfaces not in contact with forms.
 - 1. Ponding or continuous sprinkling.
 - 2. Application of absorptive mats or fabric kept continuously wet.
 - 3. Application of sand kept continuously wet.
 - 4. Continuous application of steam (not exceeding 150 DegF) or mist spray.
 - 5. Application of waterproof sheet materials, conforming to ASTM C171.
 - 6. Application of other moisture retaining covering as approved.
 - 7. Application of a curing compound conforming to ASTM C309.
 - a. Apply curing compound in accordance with manufacturer's recommendations immediately after any water sheen which may develop after finishing has disappeared from concrete surface.
 - b. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.

- c. Where a vertical surface is cured with a curing compound, the vertical surface shall be covered with a minimum of two coats of the curing compound.
 - 1) Apply the first coat of curing compound to a vertical surface immediately after form removal.
 - 2) The vertical concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
 - 3) Allow the preceding coat to completely dry prior to applying the next coat.
 - 4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
- d. Coordinate type of membrane curing compound with hot weather curing procedures.

C. Curing Concrete In Contact with Forms:

- 1. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
- 2. After form removal, cure concrete until end of time prescribed.
 - a. Use one of methods listed above.
- 3. Forms left in place shall not be used as a method of curing in hot weather.
- 4. The term "hot weather," where used in these specifications, is defined in ACI 305R.
- 5. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.

D. Continue curing for at least 7 days for all concrete except high early strength concrete for which period shall be at least 3 days. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is 1 day old, provided concrete is not permitted to become surface dry during transition.

E. Cold Weather:

- 1. Follow recommendations of ACI 306R.
- 2. Maintain temperature of concrete between 50 and 70 DegF for required curing period, when outdoor temperature is 40 DegF, or less.
- 3. Use heating, covering, insulating, or housing of the concrete work to maintain required temperature without injury due to concentration of heat.
- 4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
- 5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.

F. Hot Weather:

1. Follow recommendations of ACI 305R.
2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material.
3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.

G. Rate of Temperature Change:

1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing period.
2. Do not exceed a temperature change of 5 DegF in any 1 HR or 50 DegF in any 24 HR period.

H. Protection from Mechanical Injury:

1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration.
2. Protect finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water.
3. Do not load self supporting structures in such a way as to overstress concrete.

3.8 FIELD QUALITY CONTROL

A. Tests in accordance with Section 03350.

1. Perform a strength test on all concrete to which water or superplasticizer, in addition to the amount stated in the concrete mix design, has been added at the jobsite.
 - a. Perform strength test after water or superplasticizer has been added and additional mixing has been performed.

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

SECTION 03348
CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1- GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete finishing and repair of surface defects.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03108 - Formwork.
 - 4. Section 09900 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 116R, Cement and Concrete Terminology.
 - b. 301, Standard Specifications for Structural Concrete.
 - 2. American Society for Testing and Materials (ASTM):
 - a. C150, Standard Specification for Portland Cement.
 - b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

1.3 DEFINITIONS

- A. Vertical Surface Defects:
 - 1. Any void in the face of the concrete deeper than 1/8 IN, such as:
 - a. Tie holes.
 - b. Air pockets (bugholes).

- c. Honeycombs.
 - d. Rock holes.
- 2. Scabbing:
 - a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
- 3. Foreign material embedded in face of concrete.
- 4. Fins 1/16 IN or more in height.
- B. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 1. Installer or applicator are synonymous.
- C. Other words and terms used in these Specifications are defined in ACI 116R.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See General Requirements.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
- B. Miscellaneous Submittals:
 - 1. See General Requirements.
 - 2. Schedule of concrete structures indicating finishes of concrete surfaces.
 - 3. Certification of aggregate gradation.
 - 4. Certification that products being used will not interfere with bonding of future floor or wall finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's recommendations and requirements for materials used.

1.6 WARRANTY

- A. Provide warranty equal to specified manufacturer's standard warranty for all products used.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Chemical floor hardeners:
 - a. L & M Construction Chemicals Inc.
 - b. Euclid Chemicals Co.
 - c. Dayton Superior.
 - d. Convergent Concrete Technologies
 - e. Approved equal
 - 2. Bonding agents:
 - a. Euclid Chemical Co.
 - b. Master Builders Inc.
 - c. L & M Construction Chemicals Inc.
 - d. Approved equal
- B. Submit requests for substitution in accordance with General Requirements.

2.2 MATERIALS

- A. Floor Sealer:
 - 1. Colorless, odorless, zero VOC, environmentally safe, penetrating (non-film forming) water-based solution.
 - a. ASTM C309 Type 1, 1D.
 - 2. Design basis: L & M Construction Chemicals Inc. "Seal Hard" (see Section 03360).
- B. Bonding Agent:

1. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
 2. Euclid Chemical Co. "Flex-Con."
 3. Master Builders Inc. "Acryl-Set."
 4. L & M Construction Chemicals "Everbond."
 5. Thoro System Products "Acryl 60."
- C. Cement:
1. ASTM C150, Type I or III.
- D. Aggregate:
1. Sand: Maximum size #30 mesh sieve.
 2. For exposed aggregate finish surfaces: Same as surrounding wall.
- E. Water: Potable.

2.3 MIXES

- A. Bonding Grout:
1. One part cement to one part aggregate.
 2. Mix cement and aggregate.
 3. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
 4. Add bonding agent/water mixture to cement/aggregate mixture.
 5. Mix to consistency of thick cream.
 6. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.
- B. Patching Mortar:
1. One part cement to two and one-half parts aggregate by damp loose volume.

- a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.
2. Mix cement and aggregate.
3. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
4. Add only enough bonding agent/water mixture to cement/aggregate mixture to allow handling and placing.
5. Let stand with frequent manipulation with a trowel, until mix has reached stiffest consistency to allow placement.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Repair surface defects within 24 HRS after removal of forms.
 1. Chip, wire brush or abrasive blast to completely open defects down to sound concrete.
 - a. If chipping is necessary, make edges perpendicular to surface or slightly undercut.
 - b. No feathered edges will be permitted.
- B. Repairing Surface Defects:
 1. Fill and repair using patching mortar mix specified in Article 2.3.
 2. Clean surfaces to remove dust, dirt, laitence, form oil, grease, or other contaminants.
 - a. If required by bonding agent manufacturer, etch surfaces with a muriatic acid solution followed by a thorough rinse with clean water.
 - b. Test concrete to determine pH level and continue flushing with clean water until surface pH is within acceptable limits.
 3. Dampen area to be patched and an area at least 6 IN wide surrounding it prior to application of bonding grout.
 4. Brush bonding grout into the surface after the surface water has evaporated.

5. Allow bonding grout to set for period of time required by bonding agent manufacturer before applying premixed patching mortar.
6. Fill tie holes and areas where honeycombed or defective concrete has been removed.
 - a. Fill tie holes in liquid containing structures with non-shrink non-metallic grout. See Section 03308.
 - b. Fill all other defects with patching mortar.
 - c. Consolidate grout or mortar into place and strike off so as to leave patch slightly higher than surrounding surface.
7. Leave undisturbed for at least 60 minutes before finishing level with surrounding surface.
 - a. Do not use metal tools in finishing a patch in a formed wall which will be exposed or coated with other materials.
8. Keep areas damp for 7 days or in accordance with bonding agent manufacturer's directions.

3.2 INSTALLATION AND APPLICATION

- A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 DegF.
 - a. If necessary, enclose and heat area to between 50 and 70 DegF during repair of surface defects and curing of patching material.
- B. Floor Sealer Application:
 - a. Apply to floor areas indicated in 03311-3.5B, and the Drawings, in accordance with manufacturer's recommendations.
 - b. Apply at rate recommended by manufacturer.
 - c. After final coat of sealer is applied and dried, remove surplus sealer in accordance with manufacturer's recommendations.
 - d. Do not apply sealer to floors scheduled to receive epoxy floor finish.
- C. Concrete Finishes for Vertical Wall Surfaces:
 1. General: Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.

2. Finish #1 - As cast rough form finish:
 - a. Selected forming materials are not required.
 - b. Prepare surface in accordance with paragraph 3.1-A. and repair the following surface defects:
 - 1) Tie holes.
 - 2) Honeycombs deeper than 1/4 IN.
 - 3) Air pockets deeper than 1/4 IN.
 - 4) Rock holes deeper than 1/4 IN.
 - c. Chip or rub off fins exceeding 1/4 IN in height.
 - d. Use at unexposed surfaces such as foundations and backfilled surfaces of walls not to be waterproofed.
3. Finish #2 - Smooth form finish:
 - a. Form facing material shall produce a smooth, hard, uniform texture. Use forms specified for surfaces exposed to view in accordance with Section 03108.
 - b. Prepare surface in accordance with paragraph 3.1-A. and repair the following surface defects:
 - 1) Tie holes.
 - 2) Honeycombs deeper than 1/8 IN or larger than 1/8 IN DIA.
 - 3) Air pockets deeper than 1/8 IN or larger than 1/8 IN DIA.
 - 4) Rock holes deeper than 1/8 IN or larger than 1/8 IN DIA.
 - 5) Scabbing.
 - c. Chip or rub off fins exceeding 1/8 IN in height.
 - d. Provide finish for:
 - 1) Inside walls of tipping and operating floors and load-out area walls.
 - 2) Walls being coated with textured finish coating or some other material.

- 3) Exposed surfaces not specified to receive another finish.
4. Finish #5 - Grout cleaned finish:
 - a. Form facing material shall produce a smooth, hard, uniform texture. Use forms specified for surfaces exposed to view in accordance with Section 03108.
 - b. Prepare surface in accordance with paragraph 3.1-A. and repair all surface defects.
 - c. All contiguous surfaces to be finished shall be completed and accessible before finishing operation begins.
 - d. Mix one part Portland Cement and one and one-half parts fine sand with sufficient bonding agent/water mixture to produce a grout with the consistency of thick paint.
 - 1) White Portland cement shall be substituted for gray Portland cement to produce a color that matches color of surrounding concrete as determined by trial patch for areas not to be painted.
 - e. Wet surface of concrete to prevent absorption of water and uniformly apply grout.
 - f. Immediately after applying grout mix, scrub the surface with a cork float or stone to coat surface and fill remaining air holes, etc.
 - g. While grout is still plastic, remove all excess grout by working surface with rubber float or sack.
 - h. After the surface whitens from drying, rub vigorously with clean burlap.
 - i. Keep final finish damp for a minimum of 36 HRS after final rubbing.
 - j. Provide this finish on all surfaces which are to be painted, or as noted on the Drawings.

D. Related Unformed Surfaces (Except Slabs):

1. Strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
2. Float surface to a texture consistent with that of formed surfaces.

- a. If more than one finish occurs immediately adjacent to unformed surface, provide unformed surface with most stringent formed surface requirement.
 - 3. Continue treatment uniformly across unformed surfaces.
- E. Concrete Finishes for Horizontal Slab Surfaces:
- 1. General: Tamp concrete to force coarse aggregate down from surface. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains. Dusting of surface with dry cement or sand during finishing processes not permitted.
 - 2. Unspecified slab finish: When type of finish is not indicated, use following finishes as applicable:
 - a. Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
 - b. Floors: Troweled finish.
 - c. Exterior slabs, drive-thru slabs, sidewalks, platforms, steps and landings, and pedestrian ramps, not covered by other finish materials: Broom.
 - d. All slabs to receive a floated finish before final finishing.
 - 3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
 - 4. Floated finish:
 - a. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
 - b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations. Use wood or cork float.
 - c. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two different angles.
 - d. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
 - e. Refloat slab immediately to a uniform texture.
 - 5. Troweled finish:

- a. Float finish surface to true, even plane.
 - b. Power trowel, and finally hand trowel.
 - c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.
 - d. Perform additional trowelings by hand after surface has hardened sufficiently.
 - e. Final trowel when a ringing sound is produced as trowel is moved over surface.
 - f. Thoroughly consolidate surface by hand troweling.
 - g. Leave finished surface essentially free of trowel marks, uniform in texture, appearance and plane to a Class A tolerance.
 - h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering by grinding.
- 6. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.
 - 7. Underside of concrete slab finish: Match finish as specified for adjacent vertical surfaces.
 - a. If more than one finish occurs immediately adjacent to underside of slab surface, provide unformed surface with most stringent formed surface requirement.

3.3 FIELD QUALITY CONTROL

- A. Horizontal slab finishes will be accepted provided:
 - 1. Applicable specification requirements are satisfied.
 - 2. Water does not pond in areas sloped to drain.
 - 3. Gap between a 10 FT straightedge placed anywhere and the finished surface does not exceed:
 - a. Class A tolerance: 1/8 IN.

- b. Class B tolerance: 1/4 IN.
 - c. Class C tolerance: 1/2 IN.
- 4. Accumulated deviation from intended true plane of finished surface does not exceed 1/2 IN.
- 5. Accuracy of floor finish does not adversely affect installation and operation of movable equipment, floor supported items, or items fitted to floor (doors, tracks, etc.).
- B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.

3.4 PROTECTION

- A. All horizontal slab surfaces receiving applied toppings or sealer compound shall be kept free of traffic and loads for minimum of 10 days following installation of topping or compound.

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

SECTION 03350 TESTING

PART 1- GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Materials and concrete testing as required to establish concrete mix design.
 - 2. Testing of concrete during construction for compliance with Contract Documents.
 - 3. In-place testing of concrete, if required.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 03208 - Reinforcement.
 - 4. Section 03308 - Concrete; Materials and Proportioning.
 - 5. Section 03311 - Concrete Mixing, Placing, Jointing, and Curing.

1.2 RESPONSIBILITY AND PAYMENT

- A. Payment:
 - 1. All required concrete, mortar, grout for masonry and concrete masonry unit testing services to be paid for by Contractor. Testing services include the following:
 - a. Testing of concrete, mortar, grout for masonry, concrete masonry units and other cement-containing products produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
 - b. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
 - c. Additional testing or retesting of materials or mortar, grout for masonry, concrete failure, by test or inspection, to meet requirements of the Contract Documents.
 - d. Strength testing on any concrete to which water has been added at the jobsite.
 - e. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
 - f. Other testing services needed or required by Contractor such as:

- g. Field curing of test specimens and testing of specimens for determining when forms, form shoring, or reshoring may be removed.
 - h. All masonry inspection.
 - B. At Owner's option, Owner may at any time retain and pay for the services of a Testing Agency to perform any testing desired by the Owner.

1.3 QUALITY ASSURANCE

A. Referenced Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. T260, Standard Method of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials.
2. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
3. American Society for Testing and Materials (ASTM):
 - a. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - c. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - d. C 138, Standard Method of Test for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
 - e. C143, Standard Test Method for Slump of Hydraulic Cement.
 - f. C172, Standard Practice for Sampling Freshly Mixed Concrete.
 - g. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - h. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - i. CIO 19, Standard Test Method for Sampling and Testing Grout.
 - j. E329, Standard Specifications for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

B. Qualifications:

1. Testing Agency:
 - a. Meeting requirements of ASTM E329.

- b. Provide evidence of recent inspection by Cement and Concrete Reference Laboratory of National Bureau of Standards, and correction of deficiencies noted.

1.4 DEFINITIONS

- A. Testing Agency: An independent professional testing firm or service hired by Contractor or by Owner to perform testing and analysis services on materials, mixes, structures, and other items as directed, and as provided in the Contract Documents.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section General Requirements.
 - 2. Product technical data including:
 - a. Concrete materials and concrete mix designs proposed for use. Include results of all testing performed to qualify materials and to establish mix designs. Place no concrete until approval of mix designs has been received in writing. Submittal for each concrete mix design to include:
 - 1) Sieve analysis and source of fine and coarse aggregates.
 - 2) Test for aggregate organic impurities.
 - 3) Proportioning of all materials.
 - 4) Type of cement with mill certificate for the cement.
 - 5) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Section 03308.
 - 6) Slump.
 - 7) Brand, type and quantity of air entrainment and any other proposed admixtures.
 - 8) Total chloride ion content per cubic yard of concrete determined in accordance with AASHTO T260.
 - 9) 28-day compression test results and any other data required by Section 03308 to establish concrete mix design.
 - 3. Certifications:
 - a. Testing Agency qualifications.
 - 4. Test results:
 - a. Strength test results on concrete placed during construction including slump, air content, and concrete temperature.

- b. Strength test results on concrete core samples of in-place construction if required.
- c. Results of load testing in-place concrete construction when load testing is required.
- d. Results from all masonry testing and inspection.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.1 TESTING SERVICES TO BE PERFORMED BY CONTRACTOR'S TESTING AGENCY

- A. Review and test Contractor's proposed materials for compliance with the Contract Documents.
- B. Review and test Contractor's proposed concrete mix design(s).
- C. Conduct tests on concrete, mortar, concrete masonry units and other cement-containing products produced for incorporation into the work.
 - 1. Concrete strength tests using the following procedures:
 - a. Secure concrete samples in accordance with ASTM C172. Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
 - b. For each strength test mold and cure three cylinders from each sample in accordance with ASTM C31. Record any deviations from requirements on test report.
 - c. Test cylinders in accordance with ASTM C39. For all classes of concrete test two cylinders at 28 days for strength test result and one at 7 days for information.
 - 1) Strength test result: Average of strengths of two cylinders from the same sample tested at 28 days. If one cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard; strength of remaining cylinder shall be considered strength test result. Should both cylinders in a test show any of above defects, discard entire test.
 - d. All other concrete; one strength test consisting of 6 IN DIA x 12 IN high cylinders to be taken not less than once a day, nor less than once for each 60 CY or fraction thereof for each mix placed in any 1 day.
 - 1) If total volume of any particular concrete mix on project is such that frequency of testing required in above paragraph will provide less than five strength tests, tests shall then be

made from at least five randomly selected batches or from each batch if fewer than five batches are provided.

- D. Determine slump of concrete sample for each strength test. Determine slump in accordance with ASTM C 143.
 - 1. If consistency of concrete appears to vary, the Engineer shall be authorized to require a slump test for each concrete truck. This practice shall continue until the Engineer deems it no longer necessary.
- E. Determine air content of concrete sample for each strength test in accordance with either ASTM C231, C173, or C138.
- F. Determine temperature of concrete and concrete sample for each strength test. Monitor the temperature of all site cast concrete for a minimum of 4 days after concrete is placed.

3.2 OTHER TESTING SERVICES TO BE PERFORMED BY CONTRACTOR'S TESTING AGENCY AS NEEDED

- A. Following services to be performed by Contractor's Testing Agency when necessary at no additional cost to Owner:
 - 1. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
 - 2. Additional testing of materials or concrete occasioned by their failure, by test or inspection, to meet Specification requirements.
 - 3. Perform strength test on any concrete to which water has been added at the jobsite.
 - 4. Other testing services needed or required by Contractor, such as; field cured test specimens for determining when forms, form shoring or reshoring may be removed.
 - a. An extra strength test is required for concrete subject to either live load or shore removal prior to 28 days after placing concrete.

3.3 DUTIES AND AUTHORITIES OF TESTING AGENCY

- A. Testing Agency to inspect, sample and test materials and production of concrete as required by these Contract Documents and by Engineer. When it appears that any material furnished or work performed by Contractor fails to fulfill requirements of the Contract Documents, Testing Agency to report such deficiency to Engineer and Contractor.
- B. Testing Agency to report all test and inspection results to Engineer and Contractor immediately after they are performed. All test reports to include exact location in the work at which batch represented by a test was deposited. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.

- C. Limited Authority of Testing Agency: Any Testing Agency or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.

3.4 RESPONSIBILITIES AND DUTIES OF CONTRACTOR

- A. Provide necessary testing services for qualification of proposed materials and establishment of concrete mix design(s).
- B. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.
- C. To facilitate testing and inspection, perform the following:
 - 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
 - 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
- D. Notify Engineer and Testing Agency sufficiently in advance of operations (minimum of 24 HRS) to allow for assignment of personnel and for scheduled completion of quality tests.

3.5 EVALUATION OF CONCRETE, GROUT OR MORTAR TEST RESULTS

- A. Test results for standard molded and cured test cylinders to be evaluated separately for each mix design. Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards. For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests. A strength test shall be the average of two cylinders from the same sample tested at 28 days.
- B. Acceptance:
 - 1. Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
 - a. Average of all sets of three consecutive strength tests equal or exceed the required specified 28-day compressive strength.
 - b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.

3.6 TESTING OF CONCRETE-IN-PLACE

- A. In-place testing of concrete may be required by Engineer when strength of structure is considered potentially deficient as specified in paragraph 3.7 D.
- B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the

structure or for selecting areas to be cored. Such tests shall not be used as a basis for acceptance or rejection.

C. Core Tests:

1. Where required, obtain and test cores in accordance with ASTM C42. If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 DegF, relative humidity less than 60 percent,) for 7 days before test then test dry. If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 HRS and test wet. Testing wet or dry to be determined by Engineer.
2. Take three representative cores from each member or area of concrete in place that is considered potentially deficient. Location of cores shall be determined by Engineer so as least to impair strength of structure. If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
3. Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85 percent of specified strength and no single core is less than 75 percent of specified strength.
4. Fill core holes with nonshrink grout and finish to match surrounding surface when exposed in a finished area.

3.7 ACCEPTANCE

A. Completed concrete work which meets applicable requirements will be accepted without qualification.

1. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.
2. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents. In this event, modifications may be required to assure that concrete work complies with requirements. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

B. Dimensional Tolerances:

1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal. If

removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.

3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected. Repair or remove and replace if required.
5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.

C. Appearance:

1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the strength or function of the member.

D. Strength of Structure:

1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
 - a. Low concrete strength as specified in Article 3.5.
 - b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Section 03208 or requirements of the Contract Drawings or approved shop drawings.
 - c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
 - d. Curing time and procedure not meeting requirements of these Specifications.
 - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
 - f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
 - g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength.

2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
3. Core tests may be required when strength of concrete in place is considered potentially deficient.
4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with Chapter 20 of ACI 318.
5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

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

SECTION 15064

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required and install in the locations as shown on the Drawings, the plastic piping, fittings and appurtenances as specified herein.

1.02 RELATED WORK

- A. Excavation, Trenching, Backfilling, and Embankment is included in Section 02221.
- B. Concrete work is included in Division 3.
- C. Valves and appurtenances are included in Section 15100.

1.03 DESCRIPTION OF SYSTEM

Piping shall be installed in the locations as shown on the Drawings.

1.04 QUALIFICATIONS

- A. All plastic pipe, fittings and appurtenances shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications.
- B. Pipe shall be as manufactured by Certain Teed, Can-Tex, CPS, J-M, Napco, Diamond Plastics, or an accepted equal.

1.05 SUBMITTALS

- A. Shop drawings shall be submitted to the Engineer for approval in accordance with the General Conditions and shall include dimensioning and the technical specifications for all piping to be furnished.
- B. Submit to the Engineer, for acceptance, samples of all materials specified herein.

1.06 TOOLS

- A. Special tools, solvents, lubricants, and caulking compounds required for normal installation shall be furnished with the pipe.

PART 2 - PRODUCTS

2.01 PVC PRESSURE PIPE 4-INCHES TO 12-INCHES IN DIAMETER

- A. Except where noted on drawings, PVC pipe 4-inches in diameter and larger shall be Class 100, DR21 pressure pipe manufactured using green resin for the wastewater force main, and meeting the requirements of AWWA C-900, latest revision. Fittings for the pipe shall be mechanical joint fittings meeting the requirements of Section 15062. Pipe joints, with the exception of joints for mechanical joint fittings, shall conform to ASTM D3139 and be push-on type joints consisting of an integral pipe bell and single elastomeric ring gasket. The push-on joints shall not require the use of any couplings.

2.02 PVC PIPE FOR GRAVITY SEWERS

- A. PVC pipe for gravity sewers buried less than 20 feet shall be PVC sewer pipe with a standard dimension ratio (SDR) of 35 conforming to ASTM D3034. Joints shall be push-on joints conforming to ASTM D3212 using the integral bell with elastomeric gasket. The seals shall meet ASTM F-477 for elastomeric seals. All gaskets shall be factory installed and have a steel reinforcing ring (lick-in). The gasket shall provide an adequate compressive force so as to affect a positive seal under all combinations of joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight. Gaskets shall comply with the Low-Head Application Requirements of ASTM F477.
- B. PVC pipe and fittings for gravity sewers installed 20 feet deep or greater shall be PVC sewer pipe with a standard dimension ratio (SDR) of 26 conforming to ASTM D3034. Joints shall be push-on joints conforming to ASTM D3212 using the integral bell with elastomeric gasket. The seals shall meet ASTM F-477 for elastomeric seals. All gaskets shall be factory installed and have a steel reinforcing ring (lock-in). The gasket shall provide an adequate compressive force so as to affect a positive seal under all combinations of joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight. Gaskets shall comply with the Low-Head Application Requirements of ASTM F-477.
- C. PVC fittings such as wyes, saddles, plugs, couplings etc., shall conform to ASTM D3034 with a minimum wall thickness equivalent of SDR 28 as defined in Section 7.4.1.
- D. Gaskets shall have a minimum cross-sectional area of 0.20 square inches and conform to ASTM F-477. Specifications PVC resin shall have a cell classification of 12454 B or C as defined in ASTM 1784.

2.03 PIPE RESTRAINT

- A. Where restraint at PVC push-on pipe joints or ductile iron fittings is required, pipe restraint shall be provided by concrete thrust blocks or by mechanical restraint devices.
- B. Mechanical restraint of PVC push-on pipe joints shall be provided by restraint devices designed to provide restraint between a spigot end of pipe seton and bell end after adjoining pipe section. Devices shall be Series 1350 as manufactured by UniFlange or an accepted equal.

- C. Mechanical restraint where PVC pipe connects to a mechanical joint ductile iron fitting, restraining devices shall be Series 1300 as manufactured by UniFlange or an accepted equal.
- D. Restraint of existing pipe joints, where new pipes are being connected to existing, shall be accomplished by use of following:
 - 1. Ductile Iron Pipe: When existing pipe to be restrained is ductile iron pipe, pipe restraint shall be provided using split retainers and tie-rods. Restraint systems shall be rated for a minimum of 200 psi pressure and shall be a series 1100HD Megalug by EBAA-IRON SALES, or equal.
 - 2. PVC Pipe: When existing pipe to be restrained is PVC pipe. Pipe restraint shall be provided using split retainers and tie-rods. Restraint system shall be rated for a minimum of 200 psi pressure and shall be Megalug 2000 by EBBA Iron, Inc. or Series 1390 by Uni-Flange, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The installation of PVC pipe shall be in accordance with UNI-BELL Plastic Pipe Association Guide Specification UNI-B-3-76 and the manufacturer's instructions.
- B. Installation of valves and fittings shall be strictly in accordance with manufacturer's instruction. Particular care shall be taken not to over-stress threaded connections at sleeves.
- C. All piping shall have a sufficient number of unions to allow convenient removal of piping and shall be as accepted by the Engineer.
- D. All plastic pipe to metal pipe connections shall be made using flanged connections. Metal piping shall not be threaded into plastic fittings, valves, or couplings, nor shall plastic piping be threaded into metal valves, fittings or couplings.
- E. Locating Wire: All buried pipe shall be installed with a locating wire as detailed in the Drawings.

3.02 PIPE DISTRIBUTION

- A. Distribute material on the job no faster that it can be used to good advantage. Unload pipe which cannot be physically lifted by workers from the trucks, by a forklift, or other accepted means. Do not drop pipe of any size from the bed of the truck to the ground. Do not distribute more than one weeks supply of material in advance of laying, unless otherwise accepted by the Engineer.

3.03 PIPE PREPARATION AND HANDLING

- A. Inspect all pipe and fittings prior to lowering into trench to insure no cracked, broken, or otherwise defective materials being used. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

- B. Use proper implements, tools and facilities for the safe and proper protection of the work. Lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. Remove all damaged pipe from the job site. Do not drop or dump pipe into trenches under any circumstances.

3.04 LINE AND GRADE

- A. Contractor shall not deviate from line and grade, as established by the Engineer, more than 2-inch for line and 1/4-inch for grade, provided that such variation does not result in a level or reverse sloping invert. Measure for grade at the pipe invert, not at the top of the pipe, because of the permissible variation in pipe-wall thickness. The Contractor shall furnish and set the line and grade boards at maximum intervals of 25 feet. If grade boards prove impractical because of trench or other conditions, other methods of controlling line and grade (including laser beam) may be submitted to the Engineer for approval.
- B. If grade boards are used, a substantial stake shall be driven on each side of the trench on a line at right angles to each stake of the primary line. A straight and even-edged 2-inch by 6-inch board shall be nailed or clamped to the stakes in a level position and at some even foot height above the grade line of the proposed sewer. The centerline of the proposed sewer shall be located by measurement from the primary line stake and marked upon the board. Not less than three such lines and grade boards shall be set and immediately checked visually for errors in line and grade. As each additional board is placed, it shall be checked visually for error in line and grade. At least three boards shall be maintained at all times. During the laying of the pipe, a stout twill line shall be fastened to the boards at the center of alignment marks and pulled sufficiently tight to remove any noticeable or measurable sag. The line and grade of each pipe shall be obtained by measuring down from the string line by means of a plumbed grade pole.
- C. The Contractor may use the laser beam method of maintaining line and grade upon approval of the Engineer. Prior to approval, the Contractor shall submit evidence to the Engineer that a qualified operator will handle the equipment during the course of construction. A "Caution-Laser Light" placard shall be mounted in a conspicuous place. When "in the pipe" method is used, grade boards will be required to install the first 50 feet of pipe and the Contractor shall check the line and grade at any additional points at which offset stakes have been placed wherever so requested by the Engineer. If bending of the beam due to air temperature variations becomes apparent with "in the pipe" units, a fan shall be provided to circulate the air. However, air velocity shall not be so excessive as to cause pulsating or vibrating of the beam. If, in the opinion of the Engineer, the beam cannot be accurately controlled, this method of setting line and grade shall be discontinued. When the above ground method is used, the set-up shall be checked with the three grade boards including one set at the upstream manhole. If the laser has a gradient indicator, two boards may be used to check the set-up. The grade board at the upstream manhole shall be retained to check into as pipe laying progresses.

3.05 PREPARATION OF TRENCH

- A. Provide pipe bedding material under all pipe for the full width of the trench. Minimum depth of bedding material below the pipe barrel shall be as follows:

<u>Pipe Size</u>	<u>Minimum Depth of Bedding Under Pipe Barrel</u>
15" & Smaller	4 inches
18" to 36"	6 inches
42" & Larger	9 inches

- B. Depth of pipe bedding material under the pipe bell shall not be less than three inches under normal trench conditions.
- C. Hand-grade bedding to proper grade ahead of pipe laying operation. Heading shall provide a firm, unyielding support along the entire pipe length.
- D. If, without direction from the Engineer, the trench has been excavated below the required depth for pipe bedding material placement, fill the excess depth with pipe bedding material as specified herein to the proper subgrade.
- E. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.

3.06 DEWATERING

- A. Prevent water from entering the trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall not be laid in water.

3.07 LAYING AND JOINTING PIPE AND FITTINGS

- A. Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow. After a section of pipe has been lowered into the prepared trench, clean the end of the pipe to be joined, the inside of the joint and, if applicable, the rubber ring immediately before joining the pipe. Make assembly of the joint in accordance with the recommendations of the manufacturer of the type of joint used. Provide all special tools and appliances required for the jointing assembly.
- B. All pipe shall be laid uniformly to line and grade so that the finished sewer will present a uniform bore. Variations from line and grade in excess of the tolerances specified under LINE AND GRADE will be considered sufficient cause for rejection of the work.
- C. Check pipe for alignment and grade after the joint has been made. The pipe bedding shall form a continuous and uniform bearing and support for the pipe barrel between joints. Apply sufficient pressure in making the joint to assure that the joint is "home" as defined in the standard installation instructions provided by the pipe manufacturer. Place sufficient pipe cover material to secure the pipe from movement before the next joint is installed to assure proper pipe alignment and joint makeup.

- D. Pipe 21-inches and smaller intended to be in straight alignment shall be laid so the inside joint space does not exceed 3/8 inch in width. If interior joints on 24 inch and larger pipe laid either in straight alignment or on a curve are greater than 3/8 inch, thoroughly clean the joint surfaces and fill and seal the entire joint with premixed mortar conforming to ASTM C-387 only after the trench has been backfilled, unless otherwise accepted by the Engineer. Trowel smooth on the inside surface. Water shall not be allowed to rise in or around, or pass over any joint before it has substantially set.
- E. When pipe is laid within a movable trench shield, take all necessary precautions to prevent pipe joints from pulling apart when moving the shield ahead.
- F. Prevent excavated or other foreign material from getting into the pipe during the laying operation. Close and lock the open end of the last laid section of pipe to prevent entry of foreign material or creep of the gasketed joints when laying operations are not in progress, at the close of the day's work, or whenever the workers are absent from the job.
- G. Plug or close off pipes which are stubbed off for manhole construction or for connection by others with temporary plugs.
- H. Take all necessary precautions to prevent the "uplift" or floating of the line prior to the completion of the backfilling operation.
- I. Make connections of non-reinforced pipe to manholes or concrete structures, so that a standard pipe joint is located not more than one foot from the outside edge of the structure.
- J. When field cutting and/or machining the pipe is necessary, use only tools and methods recommended by the pipe manufacturer and accepted by the Engineer.
- K. Service lateral shall be constructed as shown on the standard sewer details and located approximately as shown on the Contract Drawings. Actual location and depth of the service lateral shall be determined by the Contractor by locating the property owner's septic tank and surrounding topography, subject to approval by the Owner's representative.

3.08 LAYING PLASTIC PIPE

- A. Polyvinyl chloride (PVC) pipe shall be installed in accordance with the instructions of the manufacturer, as shown on the Drawings and as specified herein).
- B. Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill as shown on the Drawings and as specified in Section 02221. Blocking under the pipe will not be permitted.
- C. When laying is not in progress, the open ends of the pipe shall be closed by plugs or by other accepted means.
- D. The Contractor shall use care in handling, storage and installation of pipe. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation. Under no circumstances shall pipe be dropped into the trench.

3.09 BACKFILL IN THE PIPE ZONE

- A. The pipe zone shall be considered to include the full width of the excavated trench from the bottom of the trench to a point above the top outside surface of the barrel of the pipe.
- B. Particular attention must be given to the area of the pipe zone from the flow line to the springline of the pipe to insure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone.
- C. Care shall be taken to insure that the pipe does not rest directly on the bell or pipe joint, but is uniformly supported on the barrel throughout its entire length.
- D. After the pipe is laid to line and grade, place and carefully compact pipe bedding material for the full width of the trench to the springline of the pipe. Place the material around the pipe in 6-inch layers and thoroughly hand tamp with accepted tamping sticks supplemented by "walking in" and slicing with a shovel to assure that all voids are filled.
- E. Backfill and carefully compact the area above the pipe springline with pipe cover material to a point 12 inches above the top outside surface of the pipe barrel. Pipe bedding material may, at the Contractor's option, be substituted for pipe cover material.

3.10 EXCESS TRENCH WIDTH

- A. Normal trench width shall be as defined on the Drawings. Where the normal trench width below the top of the pipe is exceeded for any reason, the Contractor shall, unless the Engineer determines that the pipe being used is strong enough for the actual trench width, furnish an adequate support for the pipe. This may be accomplished by furnishing a stronger pipe or a concrete cradle as accepted and as described below.
- B. The thickness of concrete under the pipe shall be one-third of the nominal diameter of the pipe, but not less than four inches. Concrete block or brick may be used for adjusting and maintaining proper grade and elevation of pipe. After pipe is laid to line and grade, place 3,000 psi concrete under the pipe and for the full width of the trench to form a cradle of the required length and thickness with the concrete brought up to a level equal to 1/4 of the inside pipe diameter below the springline of the pipe. Start and terminate the concrete cradle at the face of a pipe bell or collar. Do not encase pipe joints at the ends of the concrete cradle.
- C. After the concrete has taken initial set, cover material shall be placed and compacted over the concrete cradle and up to a level 12 inches above the pipe barrel and for the full width of the trench. Cover material shall be placed by hand or by equally careful means.

3.11 LEAKAGE TESTS FOR GRAVITY SEWERS - GENERAL

- A. Gravity sewers shall be required to pass a leakage test before acceptance. Leakage tests may be by the infiltration test or exfiltration test, depending on the level of the groundwater table or by the low-pressure air test all as described below.

- B. Water infiltration or air loss, as applicable, rates will be measured by the Engineer. These tests shall be performed by the Contractor under the observation of the Engineer.
- C. The groundwater height above the installed pipe shall be determined by attaching a transparent plastic tube to a pipe nipple in the manhole and using the plastic tube as a manometer.
- D. The ends of branches, laterals, tees, wyes and stubs to be included in a test section shall be plugged to prevent water or air leakage. All plugs shall be secured to prevent blowout due to internal pressure. A test section is defined as the length of sewer between manholes.
- E. The Contractor shall repair all visible leaks in manholes and pipe, even though the leakage test requirements are met.

3.12 LEAKAGE TEST - INFILTRATION METHOD

- A. The water infiltration test shall not be considered a valid leakage test unless the top surface of the groundwater level is at least seven feet above the pipe crown during the test measurement. The rate of infiltration of water into the sewers, including manholes and appurtenances, shall not exceed 100 gallons per day per inch diameter per mile of sewer. In the event groundwater does not submerge the pipe as specified, the Contractor shall conduct an exfiltration test described hereinafter.
- B. A visual inspection and an infiltration test will be conducted on all completed sewers 30 inches or more when they are submerged by groundwater as specified above. The Contractor shall provide facilities to stop inflow from adjacent sections of sewer and to provide pondage to permit measurement of infiltration. Visible leaks, defective joints and defective pipe shall be satisfactorily repaired or replaced.

3.13 LEAKAGE TEST - EXFILTRATION METHOD

- A. Sewers not submerged by groundwater shall be tested for exfiltration or, if accepted, by low-pressure air method. The Engineer reserves the right to waive the exfiltration test on any section of sewer based on his evaluation of the results of previous tests.
- B. The hydrostatic head for test purposes shall be seven feet above the sewer crown at the upstream end. Any arrangement of testing equipment which will provide observable and accurate measurement of water leakage under the specified conditions will be permitted. The rate of exfiltration of water out of the sewers, including manholes and appurtenances, shall not exceed 100 gallons per day per inch diameter per mile of sewer. Visible leaks, defective joints, and defective pipe shall be satisfactorily repaired or replaced.
- C. The sewer test section may be filled 24 hours prior to time of exfiltration testing, if desired, to permit normal absorption into the sewers walls to take place.

3.14 LEAKAGE TEST - LOW PRESSURE AIR METHOD

A. Test Procedure. The following test procedures shall be used in making each test:

1. The selection of sewer line to be tested shall be flushed and cleaned prior to conducting the low-pressure air test to clean out any debris, wet the pipe and produce more consistent results. No person is permitted in manhole while line is under pressure.
2. Isolate the section of sewer line to be tested by means of inflatable stoppers or other suitable test plugs. One of the plugs shall have an inlet tap, or other provision for connecting a hose to a portable air source.
3. If the test section is below the groundwater level, determine the height of the groundwater above the springline of the pipe at each end of the test section and compute the average. For every foot of groundwater above the pipe springline, increase the gauge test pressure by 0.43 pounds per square inch.
4. Connect the air hose to the inlet tap and a portable air source. The air equipment shall consist of necessary valves and pressure gauges to control the rate at which air flows into the test section and to enable monitoring of the air pressure within the test section. The testing apparatus shall be equipped with a pressure relief device to prevent the possibility of loading the test section with the full capacity of the compressor.
5. Add air slowly to the test section until the pressure inside the pipe is raised to 4.0 psig greater than the average back pressure of any groundwater that may be over the pipe.
6. After a pressure of 4.0 psig is obtained (max. 9.0 psig), regulate the air supply so that the pressure is maintained between 3.5 and 4.0 psig (above the average groundwater back pressure) for a period of two minutes to allow the air temperature to stabilize in equilibrium with the temperature of the pipe walls.
7. Determine the rate of air loss by the time pressure-drop method. After the two-minute air stabilization period, disconnect the air supply and adjust the pressure to 3.5 psig above the average groundwater back pressure. The time required for the test pressure to drop 1.0 psig shall be determined by means of a stopwatch and this time interval will be compared to the required time in the tables to determine if the rate of air loss is within the allowable time limit. If the time is equal to or greater than the times indicated in the tables, the pipeline shall be deemed acceptable.

B. For sewer diameter 4 inches and greater, the pipe shall be tested between adjacent manholes. The test time for the air pressure to drop the specified one pound in minutes shall be:

$$\text{Time (Min.)} = \frac{\text{Pipe Diameter (Inches)}}{2}$$

3.15 CLOSED CIRCUIT TELEVISION INSPECTION AND VIDEO-LOG

- A. A complete, final, closed circuit television inspection shall be performed on all gravity sewers, following their passing leakage and other specified testing.
- B. The Contractor shall furnish a qualified television technician, a trained supervisor, and sufficient personnel to perform all work required in the inspection operation.
- C. The Contractor shall furnish spare cameras and related equipment to prevent delays due to equipment breakdowns. Cameras shall be equipped with remote control focusing devices, remote control devices to adjust the light intensity, and enough cable shall be furnished to inspect 1,000 linear feet of sewer in a continuous operation. One camera shall be small enough to pass through a 6-inch opening.
- D. The Contractor shall clean the sewer, where required, one section at a time. After the sewer is cleaned, the television camera shall be attached to end of a rod or line so that it can be pulled through the pipeline. The camera shall trail a line of steel cable which will be attached to a winch of sufficient size to be able to pull back or retrieve the camera whenever necessary.
- E. The camera shall transmit a continuous image to the television monitor. This image shall be clear and sharp enough to enable those viewing the monitor to be able to easily see the interior condition of the pipeline being inspected.
- F. For each television inspection unit being used, the Contractor shall provide a mobile air-conditioned viewing room large enough to accommodate at least three people for the purpose of viewing the monitor while the inspection is in progress. Minimum size of the monitors shall be 17-inches, measured diagonally across the viewing screen. Electrical power to operate the equipment shall be provided by the Contractor.
- G. The Contractor shall furnish all equipment required for making a continuous video log of the view which appears on the monitor.
- H. The closed circuit television inspection shall be performed under the direct/on-site/real-time supervision of a representative of the City of Altamonte Springs. The Contractor shall prepare and furnish to the City no less than two (2) copies of the complete record video log of all gravity sewers.
- I. The cost of this work shall be included as part of the bid, and no additional compensation will be made to the Contractor.
- J. Final Acceptance of Gravity Sewers. All tests shall have been completed and accepted by the City and the Engineer before any trench is repaved. The Contractor shall be present to note required corrections, if any, detected by the television inspection, and shall schedule and complete remedial action prior to acceptance of the lines by the City.

3.16 FINAL SEWER CLEANING

- A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by the Engineer, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.
- B. Upon the Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the section and portions of the lines as required.

3.17 HYDROSTATIC TESTING FOR PRESSURE PIPING

- A. Hydrostatic tests shall consist of a pressure test and a leakage test. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints and valves including all service lines to the curb stops. Air testing of pressure pipes will not be permitted under any circumstance. Tests shall be made on sections not exceeding 2,000 feet. The Contractor shall furnish all closure pieces in the pipe as required. Equipment to be furnished by the Contractor shall include, but not be limited to, graduated containers, pressure gauges, hydraulic force pumps, and suitable hoses and piping. The Owner will monitor and approve a satisfactory test. The Contractor shall dispose of all flushing and testing water.
- B. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for his informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified. Where any section of pipe is provided with concrete thrust blocking, tests will not be made until at least five (5) days have elapsed after the thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be reduced to 24 hours if the owner concurs that the concrete has cured and reached adequate strength.
- C. All pipe sections to be tested shall be subjected to a hydrostatic test pressure of 100 psi for the wastewater force main and 150 psi for the potable water main. The duration of each test shall be for a period of 2 hours. If during the tests, the integrity of the tested line is in question, the Owner may require 6 hour tests. The basic provisions of AWWA C-600 shall be applicable.
- D. Pressure Test:

Each section of pipe to be tested, as determined by the Owner, shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, and appropriate valves installed to ensure bleeding of all air from the main. If defective pipes, fittings, valves, or hydrants are discovered in consequence of this pressure test, all such items shall be removed and replaced by the Contractor with sound material and the test shall be repeated until satisfactory results are obtained. Provisions of AWWA C-600, where applicable, shall apply.
- E. Leakage Test:

1. After completion of the pressure test, a leakage test shall be conducted to determine the quantity of water lost by leakage under the specified test pressure. Applicable provisions of AWWA C-600 shall apply.
2. Allowable leakage in gallons per hour for the pipeline shall not be greater than that determined by the formula:

$$L = \frac{ND(P)^{1/2}}{7,400}$$

Where:

L =	Allowable leakage in gallons per hour.
N =	Number of joints in the length of pipeline tested..
D =	Nominal diameter of the pipe in inches.
P =	Average test pressure during leakage test in pounds per square inch gauge.

3. Leakage is defined as the quantity of water to be supplied in the newly laid pipe or any valved section under test, which is necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled. Should any test of pipe laid disclose leakage greater than that allowed, the Contractor shall locate and replace or repair the defective joints, pipe or valves until the leakage from subsequent testing is within the specified allowance.

3.18 DISINFECTION OF PIPING

- A. Before being placed in service, all new piping shall be chlorinated in accordance with the specifications below and the procedures outlined in AWWA C-651 "Standard Procedure for Disinfecting Water Mains".
- B. Sections of pipe to be disinfected shall first be flushed (full diameter) to remove any solids or contaminated material that may have become lodged in the pipe. If no hydrant is installed at the end of the main, then a blow-off valve shall be provided large enough to develop a velocity off at least 2.5 feet per second in the main.
- C. All taps required for chlorination or flushing purposes, or for temporary or permanent release of air shall be provided for by the Contractor as a part of the construction of piping. After the disinfection, all such taps shall be sealed to the satisfaction of the Owner.
- D. Before being placed into service, all new piping and repaired portions of, or extensions to existing mains shall be chlorinated so that the initial chlorine residual is not less than 50 mg/l and that a chlorine residual of not less than 25 mg/l remains in the water after standing 24 hours in the pipe.
- E. Chlorine may be applied as a liquid chlorine (gas-water mixture), or a mixture of water and high-test calcium hypochlorite. The Contractor shall assume responsibility for safe handling of chlorine and shall meet requirements of OSHA and other regulatory agencies for safe handling of chlorine.
- F. The preferred point of application of the chlorinating agent is at the beginning of the pipe line extension or any valved section of it, and through a corporation stop inserted in the pipe. The

water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap made on the pressure side of the gate valve controlling the flow into the pipe line extension. Alternate points of applications may be used when accepted or directed by the Owner.

- G. Valves shall be manipulated by the Owner's personnel so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.
- H. Treated water shall be retained in the pipe at least 24 hours. After this period, the chlorine residual at pipe extremities and at other representative points shall be at least 25 mg/l.
- I. In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operable while the pipe line is filled with the chlorinating agent and under normal operating pressure.
- J. Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its lengths shows upon test, a free chlorine residual not in excess of that normally carried in the system.
- K. After flushing, water samples collected on 2 successive days from the treated piping system, as directed by the Owner, shall show acceptable bacteriological results. All bacteriological sampling and testing shall be provided by the Contractor. All such bacteriological analyses must be performed by a laboratory certified by the State of Florida.
- L. Proper chain of custody procedures must be followed and samples shall only be collected by certified laboratory personnel in the presence of the Owner's personnel.
- M. Copies of testing results and all related correspondence with the Florida Department of Environmental Protection (FDEP) shall be submitted to the Owner.
- N. Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure shall be repeated by the Contractor until satisfactory results are obtained.

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

SECTION 15100

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete and ready for operation all valves and appurtenances as shown on the Drawings and as specified herein.
- B. The equipment shall include, but not be limited to, the following:

1.	Gate Valves	5.	Pipe Couplings
2.	Valve Boxes	6.	Harnessing Systems
3.	Tapping Saddles	7.	Unions
4.	Backflow Preventers	8.	Pressure Gauges

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Earthwork is included in Division 2.
- B. Piping is included in the respective Sections of Division 15.

1.03 DESCRIPTION OF SYSTEMS

- A. All of the equipment and materials specified herein are intended to be standard for use in controlling the flow of water, wastewater and various other liquids depending on the applications.

1.04 QUALIFICATIONS

- A. All of the types of valves and appurtenances shall be products of well established reputable firms who are fully experienced, reputable and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

1.05 SUBMITTALS

- A. Complete shop drawings of all valves and appurtenances shall be submitted to the Engineer for approval in accordance with the requirements of the General Conditions.

1.06 TOOLS

- A. Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 - PRODUCTS

2.01 GATE VALVES

- A. Gate valves for water shall meet the requirements of AWWA C509. Valves shall be rated for 150 psi working pressure and a minimum 300 psi test pressure. Valves shall be iron body, bronze-mounted, resilient seated, and non-rising stem type. Buried valves shall have 2-inch square operating nuts; valves for above ground service shall have cast iron handwheels or chain operators with galvanized steel chains as shown on the Drawings. Handwheels shall be of ample size and shall have an arrow and the word "OPEN" cast thereon to indicate the direction of opening. All valves shall open counterclockwise. All valves shall be provided with O-ring seals. The design and machining of valves shall be such as to permit replacing the O-ring seals while in service without undue leakage.
- B. Valves for buried service shall have mechanical joints conforming to ANSI A21.11. Valves 4-inch and larger for above ground service shall have flanged joints with plain faced flanges conforming to ANSI B16.1 for Class 125 flanges. Valves 3-inch and smaller shall have threaded connections.
- C. 4-inch thru 12-inch gate valves shall be American Flow Series 2500, Mueller Series A2360, Kennedy 1571-A, or an accepted equal.
- D. Valves 2-inch and smaller shall be a Type I, Class 150 solid wedge disc, threaded ends and conforming to MSS SP-80-1979. The wheel nut shall be steel zinc plated with a cast iron hand wheel. The packing nut, gland, bonnet, disc, and body shall be bronze conforming to ASTM B-62.
- E. 2-inch and smaller shall be American Valve Mfg, Inc. Model 3FG or an accepted equal.

2.02 VALVE BOXES

- A. All buried valves shall have cast iron three piece valve boxes. Valve boxes shall be provided with suitable heavy bonnets and extend to an elevation at or slightly above the finished grade surface as directed by the Engineer. The barrel shall be two-piece, sliding type, having 5-1/4-inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall be complete with cast iron cover. Covers shall have "IRRIGATION" cast into the top as applicable to service. All valves shall have actuating nuts extended to top of valve boxes. Valve boxes shall be provided with concrete base and valve nameplate engraved with lettering 1/8-inch deep as shown on the Drawings. Valve boxes shall be manufactured by Tyler 461 S 18" –24", Tyler 562-S 24" – 36" or an accepted equal.

2.03 TAPPING SLEEVES AND VALVES

- A. Tapping sleeves shall be steel fabricated of minimum 3/8" thick carbon steel meeting ASTM A 285 Grade C. Outlet flange shall meet AWWA C-207, Class "D" ANSI 150 bl drilling and be properly recessed for the tapping valve. Bolts and nuts shall be high strength low alloy steel conforming to AWWA C111 (ANSI A21.11). Gaskets shall be galvanized natural or synthetic rubber. Sleeve shall have manufacture applied fusion bonded epoxy coating, minimum 112 mil thickness
- B. Steel tapping sleeves shall be Mueller H-304, Mueller 615, American Flow 2800, JCM 432, Ford FTSC Fast, or an Engineer's accepted equal.
- C. Tapping valves shall be Mueller T 2360-16, American Flow AFC 2500, Kennedy 950-X or an Engineer's accepted equal.

2.04 BACKFLOW PREVENTERS

- A. Backflow preventers shall be reduced pressure type backflow preventers meeting all applicable AWWA requirements and the Owner's code requirement.
- B. Backflow preventer assemblies shall be Febco 805Y, or an accepted equal.

2.05 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be of the sleeve type as shown on the Drawings and as follows:
 - a) Sleeve type steel couplings shall be used with all buried piping and where shown on the Drawings. The couplings shall be of steel and shall be Dresser Style 38, Rockwell Model 411, or equal. The couplings shall be provided high strength, low-alloy steel bolts with heavy, semi-finished hexagon nuts to ASTM A325-80 and A563-80, respectively.
 - b) Flanged adapters shall be Dresser Type 128, Rockwell Model 913, or equal.
 - c) All couplings shall be furnished with the pipe stop removed.
 - d) Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe.

2.06 HARNESSING SYSTEMS

- A. All expansion joints and pipe couplings shall be restrained with threaded tie rods and lugs. Tie rods shall be threaded rods manufactured of ASTM A36 steel and shall be hot dip galvanized. Lugs for tie rods shall connect to flange bolts and provide a device, which allows installation of tie rods outside the periphery of the pipe flanges. Lugs shall be manufactured of ductile iron and shall be as manufactured by Trumbell or an accepted equal. Washers shall be provided for all lugs; washers shall have a minimum thickness of 1/8 inch. Tie rods for restraint of the above couplings and joints shall be furnished as shown below.

B.

PIPE SIZE	NO. OF TIE RODS	ROD SIZE (INCHES)
3	2	5/8
4	2	5/8
6	2	3/4
8	2	3/4
10	2	7/8
12	2	7/8
14	4	7/8
16	4	7/8
18	4	7/8
20	4	1
24	4	1 1/4
30	6	1 1/4
36	6	1 □

2.07

UNIONS

- A. Unions on ferrous pipe 2 inches in diameter and smaller shall be 150 pound malleable iron, zinc-coated, unless indicated otherwise. Unions on water piping 2-1/2 inches in diameter and larger shall be flange pattern, 125-pound class, zinc-coated, unless indicated otherwise. Gaskets for flanged unions shall be of the best quality fiber, plastic, or leather. Unions shall not be concealed in walls, ceilings, or partitions.
- B. Unions for PVC piping shall be Type I, Grade I PVC meeting the requirements of ASTM D1784. Unions shall be Schedule 80 and shall have socket type ends and Viton O-rings.
- C. Dielectric type unions shall be used when connecting dissimilar metal piping.

2.08

PRESSURE GAUGES

- A. Each pressure gauge shall be direct mounted and include a stainless steel case and stainless steel sensing element. Gauges shall be liquid filled, and include a 4-1/2-inch diameter dial and a clear glass crystal window. Gauges shall be furnished with 1/4-inch shut-off (isolation) valves and snubbers. All gauges shall be weatherproofed. The face dial shall be white finished aluminum with jet black graduations and figures. The face dial shall indicate the units of pressure in psi. Gauges on high service pump suction lines shall have a range of 0-15 psi. Gauges on high service pump discharge lines shall have a range of 0-200 psi. Pressure gauges shall not be installed until after the substantial completion date unless otherwise requested by the Owner.
- B. Pressure gauges shall be as manufactured by Ashcroft, H.O. Trerice Company or an accepted equal.

*** END OF SECTION ***

SECTION 05500

METAL FABRICATIONS AND MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope: The types of miscellaneous metal fabrications Work includes, but is not necessarily limited to, the following:
 - 1. Aluminum stair nosings
 - 2. Vertical ladder
 - 3. Pipe bollards
- B. Related Sections:
 - 1. Section 03255, Anchor Bolts, Expansion Anchors and Concrete Inserts
 - 2. Section 09900, Painting

1.02 QUALITY ASSURANCE

- A. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ASTM A 36, Structural Steel
 - 2. ASTM A 123, Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
 - 3. ASTM A 153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. ASTM A 240, Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Fusion-Welded Unfired Pressure Vessels
 - 5. ASTM A 320, Alloy Steel Bolting Material for Low Temperature Service
 - 6. ASTM A 386, Zinc Coating (Hot-Dip) on Assembled Steel Products
 - 7. ASTM B 209, Aluminum-Alloy Sheet and Plate
 - 8. ANSI A14.3, Safety Requirements for Fixed Ladders
 - 9. AWS D1.1, Structural Welding Code
 - 10. AISI Standards for Stainless Steel
- B. Design Criteria: The size and spacing of expansion bolts, anchor bolts, cast-in-place inserts and similar items shown or specified shall be considered the minimum acceptable size. Final selection of these items shall be based upon the actual design load times a minimum safety factor of four. Where the size and spacing of expansion bolts, anchor bolts, cast-in-place inserts and similar items are not shown or are not specified, CONTRACTOR shall provide such items of sufficient size, length, load carrying capacity and spacing required to carry the design load times a minimum safety factor of four. Provide non-corrosive materials for all such items.

-
- C. Field Measurement: Take field measurements where required prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.
 - D. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
 - E. Coating: Manufacturer shall shop prime per Section 09900.

1.03 SHOP DRAWINGS

- A. Submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal fabrications work.
- B. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Verify field measurements prior to submission of shop drawings to ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Steel Sections: ASTM A36.
- B. Stainless Steel Sheet and Plate: ASTM A 240.
- C. Bolts, Nuts and Washers: ASTM A307, or ASTM A 325.
- D. Welding materials: AWS D1.1; type required for materials being welded.
- E. Aluminum
 - 1. Extruded shapes and tubes: ASTM B221
 - 2. Plate and sheet: ASTM B209
 - 3. Bars, rods and wire: ASTM B211
 - 4. Stainless Steel Fasteners and Fittings: ASTM A320
 - 5. Zinc Coated Hardware: ASTM A 153
- F. Primer: All steel shall be primed in the shop. Surface preparation and shop priming are specified in Section 09900, Painting.

2.02 METAL FABRICATIONS

- A. Stair Safety Tread Nosings:
 - 1. Safety tread nosings (safety tread inserts) shall be provided for all concrete stairs,

-
- treads, edges of platforms and landings, and other locations indicated on the Drawings.
- a. Material: 6063 extruded aluminum alloy with factory-applied metallized grit surface.
 - b. Finish: Mill.
2. Nosings shall end not more than three inches from each end of the tread, platform, or landing and shall be set to finish flush with adjacent surfaces. Nosings shall be approximately 3 inches wide and 3 inches thick. Anchors or attachments shall be set near each end and staggered approximately 13 inches apart.
 3. Set nosings level and straight. Upon completion, surface of nosings shall be clean, free from concrete or other foreign matter and firmly anchored in place.
 4. Product and Manufacturer: Provide one of the following:
 - a. IKG MEBAC Type B-3C and 3E
 - b. Or equal.
- B. Vertical Ladders:
1. Provide fixed vertical aluminum ladders as indicated on the drawings. Side rails shall be 1/2 inch x 2-1/2 inch bars with rounded ends. Side rails shall be 18 inches apart. Rungs shall be 3/4 inch diameter bars at 12-inch centers, extending flush with the outside face and fully welded to the side rails. Provide non-slip surface on the top of each rung. Outside ends of ladders shall be 7 inches from wall.
 2. Brackets shall be of the same stock as side rails. Locate brackets at tops and bottoms of ladders and at intermediate points not over five feet apart, welded to the side rails. Brackets shall be shaped with an outstanding leg of sufficient length to hold the center of rungs at least seven inches away from walls. Each bracket shall be fastened to the wall with 1/2" diameter Type 316 stainless steel expansion anchors.
 3. Material: Provide aluminum ladders and brackets for all installations unless otherwise indicated on the Drawings.
- C. Bollards: Provide 6-inch diameter steel pipe as shown on the Drawings.
- D. Metal Canopy: Furnish and install steel canopies as shown on the Drawings. Canopies shall have a baked-on finish and shall be installed per manufacturer's recommendations. Finish color shall be as selected by ENGINEER.
- E. Miscellaneous Framing and Supports:
1. Provide miscellaneous metal framing, supports and other metal items required which are not a part of the structural steel framework and are required to complete the Work.
 2. Fabricate miscellaneous units to the sizes, shapes and profiles shown or, if not shown, of the required dimensions to receive adjacent grating, plates, tanks, doors, or other work to be retained by the framing. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection. Cut, drill and tap units to receive hardware and similar items to be anchored to the Work.

-
- F. Primer Paint: Unless otherwise shown or specified, prepare surfaces and prime steel items as required under Section 09900, Painting, of these Specifications.
 - G. Galvanizing: All galvanizing of fabricated steel items to comply with the requirements of ASTM A 123.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Obtain ENGINEER approval prior to site cutting or making adjustments not scheduled.
- B. Clean and strip site primed steel items to bare metal where site welding is scheduled.
- C. Make provisions for erection loads with temporary bracing. Keep work in alignment.
- D. Supply items required to be cased into concrete or embedded in masonry with setting templates to appropriate sections.
- E. Surface preparation and painting is required for all ferrous metals, equipment and accessories. Stainless steel shall not be painted.
- F. Galvanizing: All galvanizing of fabricated steel items to comply with the requirements of ASTM A 123.

3.02 FABRICATION

- A. Verify dimensions on site prior to shop fabrication.
- B. Fabricate items with joints tightly fitted and secured.
- C. Fit and shop assemble in largest practical sections for delivery to site.
- D. Grind exposed welds flush and smooth with adjacent finished surface. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of structure, except where specifically noted otherwise.
- F. Make exposed joints butt tight, flush, and hairline.
- G. Supply components required for anchorage of metal fabrications. Fabricate anchorage and related components of same materials and finish as metal fabrication, except where specifically noted otherwise. Supply sleeves as required for mounting of newel posts in concrete.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Perform field welding in accordance with AWS D1.1.
- C. After installation, touch up field welds, scratched or damaged surfaces with primer.

3.04 FINISH

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact bond with concrete or where field welding is required.
- C. Prime paint all metal fabrications.
- D. Field paint all metal fabrication.

END OF SECTION

Pinnacle Agriculture Holdings, LLC
Office Building

Structural observations are not considered part of the structural tests and special inspections and do not replace inspections and testing by the testing agency or special inspector.

- E. Special Inspector: A qualified person who demonstrating competence, to the satisfaction of the code enforcement official and registered design professional in responsible charge, for inspection of the particular type of construction or operation requiring special inspection. The special inspector shall be a licensed professional engineer or engineering intern or a qualified representative from the testing agency.
- F. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
- G. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- H. Testing Agency: A qualified materials testing laboratory under the responsible charge of a licensed professional engineer, approved by the code enforcement official and the registered design professional in responsible charge, to measure, examine, test, calibrate, or otherwise determine the characteristics or performance of construction materials and verify confirmation with construction documents.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Minimum qualifications of inspection and testing agencies and their personnel shall comply with ASTM E329-03 Standard Specification for Agencies in the Testing and / or Inspection of Materials Used in Construction.
 - a. Inspectors and individuals performing tests shall be certified for the work being performed as outlined in the appendix of the ASTM E329. Certification by organizations other than those listed must be submitted to the building official for consideration before proceeding with work.
 - 2. In addition to these requirements, local jurisdiction may have additional requirements. It is the responsibility of the testing and inspection agencies to meet local requirements and comply with local procedures.

1.5 CONFLICTING REQUIREMENTS, REPORTS, AND TEST RESULTS

- 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 the registered design professional in responsible charge 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 the registered design profession in responsible charge for a decision before proceeding.
- C. The special inspector's reports and testing agencies results shall have precedence over reports and test results provided by the contractor.

Pinnacle Agriculture Holdings, LLC
Office Building

- D. Where a conflict exists between the construction documents and approved shop drawings / submittal data, the construction documents shall govern unless the shop drawings / submittal data are more restrictive. All conflicts shall be brought to the attention of the registered design professional in responsible charge.

1.6 SUBMITTALS BY SPECIAL INSPECTOR AND / OR TESTING AGENCY

- A. Special inspectors shall keep and distribute records of inspections. The special inspector shall furnish inspection reports to the building official, and to the registered design professional in responsible charge, contractor, and owner. Reports shall indicate that work inspected was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and to the registered design professional in responsible charge prior to the completion of that phase of the work. A final report documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted at a point in time agreed upon by the permit applicant and the building official prior to the start of work.
 - 1. Special inspection reports and test results shall include, but not be limited to, the following:
 - a. Date of inspection.
 - b. Description of inspections or tests performed including location (reference grid lines, floors, elevations, etc.).
 - c. Statement noting that the work, material, and / or product conforms or does not conform to the construction document requirements.
 - 1) Name and signature of contractor's representative who was notified of work, material, and / or products that do not meet the construction document requirements.
 - d. Name and signature of special inspector and / or testing agency representative performing the work.
- B. Schedule of Non-Compliant Work: Each agent shall maintain a log of work that does not meet the requirements of the construction documents. Include reference to original inspection / test report and subsequent dates of re-inspection / retesting.
- C. Reports and tests shall be submitted within 1 week of inspection or test. Schedule of Non-Compliant Work shall be updated daily and submitted at monthly intervals.
- D. Final Report of Special Inspections. Submitted by each agent listed in the schedule of Structural Testing and Special Inspections.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S RESPONSIBILITY

- A. The contractor shall coordinate the inspection and testing services with the progress of the work. The contractor shall provide sufficient notice to allow proper scheduling of all personnel. The contractor shall provide safe access for performing inspection and on site testing.
- B. The contractor shall submit schedules to the owner, registered design professionals and testing and inspecting agencies. Schedules will note milestones and durations of time for materials requiring structural tests and special inspections.

Pinnacle Agriculture Holdings, LLC
Office Building

- C. Each contractor responsible for the construction of a seismic-force-resisting system, designated seismic system, or component listed in the quality assurance plan shall submit a written contractor's statement of responsibility to the building official and to the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:
 - 1. Acknowledgment of awareness of the special requirements contained in the quality assurance plan.
 - 2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official.
 - 3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports.
 - 4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- D. Each contractor responsible for the construction of a main wind force-resisting system or a wind-resisting component listed in the quality assurance plan shall submit a written statement of responsibility to the building official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:
 - 1. Acknowledgment of awareness of the special requirements contained in the quality assurance plan.
 - 2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official.
 - 3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports.
 - 4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- E. The contractor shall repair and / or replace work that does not meet the requirements of the construction documents.
 - 1. Contractor shall engage an engineer to prepare repair and / or replacement procedures.
 - 2. Engineer shall be registered in the state in which the project is located. Engineer shall be acceptable to the registered design professional in responsible charge, code enforcement official, and owner.
 - 3. Procedures shall be submitted for review and acceptance by the registered design professional in responsible charge, code enforcement official, and owner before proceeding with corrective action.
- F. The contractor shall be responsible for costs of:
 - 1. Re-testing and re-inspection of materials, work, and / or products that do not meet the requirements of the construction documents and shop drawings / submittal data.
 - 2. Review of proposed repair and / or replacement procedures by the registered design professional in responsible charge and the inspectors and testing agencies.
 - 3. Repair or replacement of work that does not meet the requirements of the construction documents.

3.2 STRUCTURAL OBSERVATIONS

- A. Structural observations may be made periodically as determined by the registered design professional in responsible charge.

3.3 TESTING AND INSPECTION

- A. Testing and inspection shall be in accordance with the attached Schedule of Special Inspections.

Pinnacle Agriculture Holdings, LLC
Office Building

- B. Reference related specifications for the minimum level of inspections and testing. Provide additional inspections and testing as necessary to determine compliance with the construction drawings.

PART 4 - FORMS (ATTACHED)

- 4.1 STATEMENT OF SPECIAL INSPECTIONS.
- 4.2 FINAL REPORT OF SPECIAL INSPECTIONS.

END OF SECTION 014100

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Slabs-on-grade.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Curing compounds.
 - 6. Bonding agents.
 - 7. Adhesives.

Pinnacle Agriculture Holdings, LLC
Office Building

8. Vapor retarders.
9. Semi-rigid joint filler.
10. Joint-filler strips.
11. Repair materials.

- B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Engage a qualified independent testing agency to design concrete mixtures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

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

Pinnacle Agriculture Holdings, LLC
Office Building

1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I, Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A (6 mil). Include manufacturer's recommended adhesive or pressure-sensitive tape.
- B. Granular Fill: As Indicated.

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

Pinnacle Agriculture Holdings, LLC
Office Building

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Damp Curing: Seven day cure.
- G. At All Interior Slabs: Use L&M Cure R-2 water-based, dissipating resin curing compound as manufactured by L&M Construction Chemicals, Inc. Install per manufacturer recommendations.

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

Pinnacle Agriculture Holdings, LLC
Office Building

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 3. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
- B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
 3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

Pinnacle Agriculture Holdings, LLC
Office Building

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

Pinnacle Agriculture Holdings, LLC
Office Building

- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

Pinnacle Agriculture Holdings, LLC
Office Building

3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action

Pinnacle Agriculture Holdings, LLC
Office Building

will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

Pinnacle Agriculture Holdings, LLC
Office Building

- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

Pinnacle Agriculture Holdings, LLC
Office Building

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing

Pinnacle Agriculture Holdings, LLC
Office Building

operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

Pinnacle Agriculture Holdings, LLC
Office Building

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

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

Pinnacle Agriculture Holdings, LLC
Office Building

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner may engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Headed bolts and studs.
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

Pinnacle Agriculture Holdings, LLC
Office Building

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

FINAL REPORT OF SPECIAL INSPECTIONS

Project: Pinnacle Office Building

Project Address:

Testing / Inspection Agent:

Testing / Inspection Agent Address:

Scope of Testing / Inspections:

(To be completed by Testing / Inspection Agent)

To the best of my information, knowledge, and belief, the special inspections or testing required for this project, and designated for this Agent in the *Schedule of Special Inspections* submitted for permit, have been completed in accordance with the contract documents.

Interim reports submitted prior to this final report and numbered to , form a basis for, and are to be considered an integral part of this final report. The following discrepancies that were outstanding since the last interim report dated have been corrected:

(Attach 8 1/2" x 11" continuation sheet(s) if required to complete the description of corrections)

Prepared By:

Type or print name

Signature

Date

Special Inspector's Seal

(Licensed Professional Engineer)



STATEMENT OF SPECIAL INSPECTIONS

Project: Pinnacle Office Building

Project Address:

Permit Applicant:

Applicant Address:

Owner: Pinnacle Agriculture Holdings, LLC

Owner Address:

Registered Design Professionals (RDP):

Architect:

Geotechnical Engineer:

Structural Engineer: Neel-Schaffer

Mechanical Engineer:

Electrical Engineer:

This statement of special inspections is submitted as a condition for permit issuance in accordance with Chapter 17 of the International Building Code. It includes a *Schedule of Special Inspections* applicable to the above referenced project as well as the identity of the individuals, agencies, or firms intended to be retained for conducting these inspections.

The Special Inspector(s) shall keep records of all inspections and shall furnish interim inspection reports to the building official and to the registered design professional in responsible charge at a frequency agreed upon by the permit applicant and building official prior to the start of work. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and the registered design professional in responsible charge prior to completion of that phase of work. A *Final Report of Special Inspections* documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted by each agent at the completion of that phase of work.

Maximum frequency of interim report submittals shall not be less than _____.

The Special Inspection program does not relieve the contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Owner's Acknowledgement:

Signature

Date

Building Official's Acceptance:

Signature

Date

Permit No.

Frequency of interim report submittals to building official:

☐ Monthly

☐ Bi-Monthly

☐ Upon Completion

☐ Per Attached Schedule

RDP in Responsible Charge



SECTION 014100 – STRUCTURAL TESTS AND SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements required for compliance with the International Building Code, Chapter 17, Structural Tests and Special Inspections.
- B. Structural testing and special inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve contractor of responsibility for compliance with other construction document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the construction document requirements.
 - 3. Requirements for contractor to provide quality-assurance and -control services required by owner or authorities having jurisdiction are not limited by provisions of this section.
- C. The owner will engage one or more qualified special inspectors and / or testing agencies to conduct structural tests and special inspections specified in this section and related sections and as maybe specified in other divisions of these specifications.
- D. Related Sections include but are not limited to the following:
 - 1. 033000 CAST-IN-PLACE CONCRETE.

1.3 DEFINITIONS

- A. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the building official.
- B. Construction Documents: Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building permit. Construction Documents include all supplemental instructions, sketches, addenda, and revisions to the drawings and specifications issued by the registered design professional beyond those issued for a building permit.
- C. Shop Drawings / Submittal Data: Written, graphic and pictorial documents prepared and / or assembled by the contractor based on the Construction Documents.
- D. Structural Observation: Visual observation of the structural system by a representative of the registered design professional's office for general conformance to the approved construction documents.

Pinnacle Agriculture Holdings, LLC
Warehouse

Structural observations are not considered part of the structural tests and special inspections and do not replace inspections and testing by the testing agency or special inspector.

- E. Special Inspector: A qualified person who demonstrating competence, to the satisfaction of the code enforcement official and registered design professional in responsible charge, for inspection of the particular type of construction or operation requiring special inspection. The special inspector shall be a licensed professional engineer or engineering intern or a qualified representative from the testing agency.
- F. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
- G. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- H. Testing Agency: A qualified materials testing laboratory under the responsible charge of a licensed professional engineer, approved by the code enforcement official and the registered design professional in responsible charge, to measure, examine, test, calibrate, or otherwise determine the characteristics or performance of construction materials and verify confirmation with construction documents.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Minimum qualifications of inspection and testing agencies and their personnel shall comply with ASTM E329-03 Standard Specification for Agencies in the Testing and / or Inspection of Materials Used in Construction.
 - a. Inspectors and individuals performing tests shall be certified for the work being performed as outlined in the appendix of the ASTM E329. Certification by organizations other than those listed must be submitted to the building official for consideration before proceeding with work.
 - 2. In addition to these requirements, local jurisdiction may have additional requirements. It is the responsibility of the testing and inspection agencies to meet local requirements and comply with local procedures.

1.5 CONFLICTING REQUIREMENTS, REPORTS, AND TEST RESULTS

- 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 the registered design professional in responsible charge 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 the registered design profession in responsible charge for a decision before proceeding.
- C. The special inspector's reports and testing agencies results shall have precedence over reports and test results provided by the contractor.

Pinnacle Agriculture Holdings, LLC
Warehouse

- D. Where a conflict exists between the construction documents and approved shop drawings / submittal data, the construction documents shall govern unless the shop drawings / submittal data are more restrictive. All conflicts shall be brought to the attention of the registered design professional in responsible charge.

1.6 SUBMITTALS BY SPECIAL INSPECTOR AND / OR TESTING AGENCY

- A. Special inspectors shall keep and distribute records of inspections. The special inspector shall furnish inspection reports to the building official, and to the registered design professional in responsible charge, contractor, and owner. Reports shall indicate that work inspected was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and to the registered design professional in responsible charge prior to the completion of that phase of the work. A final report documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted at a point in time agreed upon by the permit applicant and the building official prior to the start of work.
 - 1. Special inspection reports and test results shall include, but not be limited to, the following:
 - a. Date of inspection.
 - b. Description of inspections or tests performed including location (reference grid lines, floors, elevations, etc.).
 - c. Statement noting that the work, material, and / or product conforms or does not conform to the construction document requirements.
 - 1) Name and signature of contractor's representative who was notified of work, material, and / or products that do not meet the construction document requirements.
 - d. Name and signature of special inspector and / or testing agency representative performing the work.
- B. Schedule of Non-Compliant Work: Each agent shall maintain a log of work that does not meet the requirements of the construction documents. Include reference to original inspection / test report and subsequent dates of re-inspection / retesting.
- C. Reports and tests shall be submitted within 1 week of inspection or test. Schedule of Non-Compliant Work shall be updated daily and submitted at monthly intervals.
- D. Final Report of Special Inspections. Submitted by each agent listed in the schedule of Structural Testing and Special Inspections.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S RESPONSIBILITY

- A. The contractor shall coordinate the inspection and testing services with the progress of the work. The contractor shall provide sufficient notice to allow proper scheduling of all personnel. The contractor shall provide safe access for performing inspection and on site testing.
- B. The contractor shall submit schedules to the owner, registered design professionals and testing and inspecting agencies. Schedules will note milestones and durations of time for materials requiring structural tests and special inspections.

Pinnacle Agriculture Holdings, LLC
Warehouse

- C. Each contractor responsible for the construction of a seismic-force-resisting system, designated seismic system, or component listed in the quality assurance plan shall submit a written contractor's statement of responsibility to the building official and to the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:
 - 1. Acknowledgment of awareness of the special requirements contained in the quality assurance plan.
 - 2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official.
 - 3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports.
 - 4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- D. Each contractor responsible for the construction of a main wind force-resisting system or a wind-resisting component listed in the quality assurance plan shall submit a written statement of responsibility to the building official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:
 - 1. Acknowledgment of awareness of the special requirements contained in the quality assurance plan.
 - 2. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official.
 - 3. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports.
 - 4. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- E. The contractor shall repair and / or replace work that does not meet the requirements of the construction documents.
 - 1. Contractor shall engage an engineer to prepare repair and / or replacement procedures.
 - 2. Engineer shall be registered in the state in which the project is located. Engineer shall be acceptable to the registered design professional in responsible charge, code enforcement official, and owner.
 - 3. Procedures shall be submitted for review and acceptance by the registered design professional in responsible charge, code enforcement official, and owner before proceeding with corrective action.
- F. The contractor shall be responsible for costs of:
 - 1. Re-testing and re-inspection of materials, work, and / or products that do not meet the requirements of the construction documents and shop drawings / submittal data.
 - 2. Review of proposed repair and / or replacement procedures by the registered design professional in responsible charge and the inspectors and testing agencies.
 - 3. Repair or replacement of work that does not meet the requirements of the construction documents.

3.2 STRUCTURAL OBSERVATIONS

- A. Structural observations may be made periodically as determined by the registered design professional in responsible charge.

3.3 TESTING AND INSPECTION

- A. Testing and inspection shall be in accordance with the attached Schedule of Special Inspections.

Pinnacle Agriculture Holdings, LLC
Warehouse

- B. Reference related specifications for the minimum level of inspections and testing. Provide additional inspections and testing as necessary to determine compliance with the construction drawings.

PART 4 - FORMS (ATTACHED)

- 4.1 STATEMENT OF SPECIAL INSPECTIONS.
- 4.2 FINAL REPORT OF SPECIAL INSPECTIONS.

END OF SECTION 014100

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Slabs-on-grade.
 - 3. Foundation and Building Walls.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Curing compounds.
 - 6. Bonding agents.

Pinnacle Agriculture Holdings, LLC
Warehouse

7. Adhesives.
8. Vapor retarders.
9. Semi-rigid joint filler.
10. Joint-filler strips.
11. Repair materials.

- B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- E. Concrete Testing Service: Engage a qualified independent testing agency to design concrete mixtures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire,

Pinnacle Agriculture Holdings, LLC
Warehouse

plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

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

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

- B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A (6 mil). Include manufacturer's recommended adhesive or pressure-sensitive tape.

- B. Granular Fill: As Indicated.

2.7 CURING MATERIALS

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

Pinnacle Agriculture Holdings, LLC
Warehouse

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Damp Curing: Seven day cure.
- G. At All Interior Slabs: Use L&M Cure R-2 water-based, dissipating resin curing compound as manufactured by L&M Construction Chemicals, Inc. Install per manufacturer recommendations.

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

Pinnacle Agriculture Holdings, LLC
Warehouse

- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 25 percent.
 2. Combined Fly Ash and Pozzolan: 25 percent.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 3. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

Pinnacle Agriculture Holdings, LLC
Warehouse

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

C. Foundation and Building Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
 2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.

Pinnacle Agriculture Holdings, LLC
Warehouse

- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

Pinnacle Agriculture Holdings, LLC
Warehouse

- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

Pinnacle Agriculture Holdings, LLC
Warehouse

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

Pinnacle Agriculture Holdings, LLC
Warehouse

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- 3.9 FINISHING FORMED SURFACES
- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.

Pinnacle Agriculture Holdings, LLC
Warehouse

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

3.10 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
 - 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Owner before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.12 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

Pinnacle Agriculture Holdings, LLC
Warehouse

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to

Pinnacle Agriculture Holdings, LLC
Warehouse

reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

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

- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner may engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Headed bolts and studs.
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

Pinnacle Agriculture Holdings, LLC
Warehouse

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
6. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

FINAL REPORT OF SPECIAL INSPECTIONS

Project: Pinnacle Warehouse

Project Address:

Testing / Inspection Agent:

Testing / Inspection Agent Address:

Scope of Testing / Inspections:

(To be completed by Testing / Inspection Agent)

To the best of my information, knowledge, and belief, the special inspections or testing required for this project, and designated for this Agent in the *Schedule of Special Inspections* submitted for permit, have been completed in accordance with the contract documents.

Interim reports submitted prior to this final report and numbered [] to [], form a basis for, and are to be considered an integral part of this final report. The following discrepancies that were outstanding since the last interim report dated [] have been corrected:

(Attach 8 1/2" x 11" continuation sheet(s) if required to complete the description of corrections)

Prepared By:

Type or print name

Signature

Date

Special Inspector's Seal

(Licensed Professional Engineer)



STATEMENT OF SPECIAL INSPECTIONS

Project: Pinnacle Warehouse

Project Address:

Permit Applicant:

Applicant Address:

Owner: Pinnacle Agriculture Holdings, LLC

Owner Address:

Registered Design Professionals (RDP):

Architect:

Geotechnical Engineer:

Structural Engineer: Neel-Schaffer

Mechanical Engineer:

Electrical Engineer:

This statement of special inspections is submitted as a condition for permit issuance in accordance with Chapter 17 of the International Building Code. It includes a *Schedule of Special Inspections* applicable to the above referenced project as well as the identity of the individuals, agencies, or firms intended to be retained for conducting these inspections.

The Special Inspector(s) shall keep records of all inspections and shall furnish interim inspection reports to the building official and to the registered design professional in responsible charge at a frequency agreed upon by the permit applicant and building official prior to the start of work. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and the registered design professional in responsible charge prior to completion of that phase of work. A *Final Report of Special Inspections* documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted by each agent at the completion of that phase of work.

Maximum frequency of interim report submittals shall not be less than _____.

The Special Inspection program does not relieve the contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Owner's Acknowledgement:

Signature

Date

Building Official's Acceptance:

Signature

Date

Permit No.

Frequency of interim report submittals to building official:

☐ Monthly

☐ Bi-Monthly

☐ Upon Completion

☐ Per Attached Schedule

RDP in Responsible Charge



SECTION 13 3419 - METAL BUILDING SYSTEMS

1.1 METAL BUILDING SYSTEMS COMPONENTS

- A. Clear span rigid frame.
- B. Bay spacing per contract documents.
- C. Roof Slope per contract documents.
- D. Primary Framing: Rigid frame of rafter beams and columns with one end wall constructed for future expansion as denoted on the drawings.
- E. Secondary Framing: Purlins, girts, eave struts, flange bracing and other items detailed.
- F. Lateral Bracing: Horizontal loads not resisted by main frame action shall be resisted by cable, rod and/or diaphragm, portal frames or fixed base columns in the sidewall. Diaphragm and/or cable, rod, portal frame, or fixed base columns in the end-wall. Cable, rod and/or diaphragm in the roof.
- G. Wall and Roof System: Preformed steel panels.
- H. Accessories: louvers and exhaust fans.

1.2 REFERENCES

- A. AISI – *North American Specification for the Design of Cold-Formed Steel Structural Members*, including 2004 Supplement.
- B. AISC 360 - *Specification for Structural Steel Buildings*, 2005.
- C. AISC - Steel Design Guide Series 3 - Serviceability Design Considerations for Low-Rise Buildings, Second Edition, 2003.
- D. ANSI/ASHRAE/IESNA Standard 90.1 – 2004 - *Energy Standard for Buildings except Low-Rise Residential Buildings*.
- E. ASTM A36-04 - Specification for Carbon Structural Steel.
- F. ASTM A123-02 - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- G. ASTM A153-04 - Specification for Zinc Coating (Hot Dip) on Iron and steel Hardware.
- H. ASTM A307-04 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- I. ASTM A325-04b - Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- J. ASTM A463-02a - Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process.
- K. ASTM A475-03 - Specification for Zinc-Coated Steel Wire Strand.
- L. ASTM A490-04a - Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.

- M. ASTM A500-03a - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- N. ASTM A501-01 - Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- O. ASTM A529-04 - Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
- P. ASTM A572-04 - Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- Q. ASTM A653-04a - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.
- R. ASTM A792-03 - Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- S. ASTM A1011-04a - Specification for Steel Sheet and Strip Hot Rolled Carbon, Structural High Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.
- T. ASTM C665-01 - Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- U. ASTM D1494-97(2001) - Test Method for Diffused Light Transmission Factor of Reinforced Plastic panels.
- V. ASTM E1514-98(2003) - Specification for Structural Standing Seam Steel Roof panel Systems.
- W. ASTM E1592-01 - Test method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- X. ASTM E1646-95(2003) - Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
- Y. ASTM E1680-95(2003) - Test Method of Rate of Air Leakage through Exterior metal Roof Panel Systems.
- Z. AWS A2.4 - Standard Welding Symbols, 1998. AA.
AWS D1.1 - Structural Welding Code - Steel, 2000.
- AB. AWS D1.3 - Structural Welding Code - Sheet Steel, 1998. AC.
MBMA Metal Building Systems Manual, 2012.
- AD. NAIMA 202 - Standard for Flexible Fiberglass Insulation Systems in Metal Buildings, 2000.
- AE. SJI (Steel Joist Institute) - Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, 41st Edition.
- AF. SSPC (Society for Protective Coatings) - SP-2 - Specification for Hand Tool Cleaning, 2004 (Part of Steel Structures Painting Manual, Vol. Two)
- AG. SSPC - Paint 15 – Steel Joist Shop Primer/Metal Building Primer; Society for Protective Coatings; 2004 (Part of Steel Structures Painting Manual, Vol. Two)
- AH. SSPC – Paint 20 – Zinc-Rich Primers (Type I, “Inorganic”, and Type II, “Organic”); Society for Protective Coatings; 1991 (Part of Steel Structures Painting Manual, Vol. Two).
- AI. UL 580 - Tests for Uplift Resistance of Roof Assemblies, 1994.

1.3 DESIGN REQUIREMENTS

- A. The building shall be designed by the Manufacturer as a complete system. All components of the system shall be supplied or specified by the same manufacturer.
- B. Design Code:
Design shall be in accordance with IBC 2012 unless overwritten by local code.
- C. Energy Code: as required by local code.
- D. Dead Loads:
The dead load shall be the weight of the Metal Building System and as determined by the system manufacturer.
- E. Collateral Loads:
The collateral load shall be as shown on the contract drawings. Collateral Loads shall not be applied to the roof panels.
- F. Live Loads:
The building system shall be capable of supporting a minimum uniform live load of 20 psf., reducible
- G. Snow Loads: shall be determined by local code.
- H. Wind Loads: IBC 2012 in accordance with local code.
- I. Seismic Loads: as required by local code.
- J. Rainfall Intensity: as required by local code.
All exterior gutters and downspouts shall be designed for rainfall intensity based upon a 5-year recurrence interval for a one hour duration.
- K. Deflection requirements shall be in accordance with the applicable provisions of the AISC Steel Design Guide Series 3 - Serviceability Design Considerations for Steel Buildings, per IBC 2012.

1.4 SUBMITTALS

Note: All manufacturer's drawings and design calculations shall bear the professional seal and signature of a licensed professional engineer registered in the state of jurisdiction of the project.

- A. Submit anchor bolt placement plan, column reactions, in advance of erection drawings.
- B. Product Data: Provide data on profiles, component dimensions, fasteners, and color selection.
- C. Manufacturer's Installation Instructions: Indicate preparation requirements and assembly sequence.

- D. Shop or Erection Drawings: Indicate assembly dimensions, locations of structural members, connections, attachments, openings, cambers, and loads; wall and roof system dimensions, panel layout, general construction details, anchorages and method of anchorage, and installation; framing anchor bolt settings, sizes, and locations from datum, and foundation loads; indicate field welded connections with AWS A2.4 welding symbols; indicate net weld lengths.

1.5 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with MBMA Metal Building Systems Manual, and, for items not covered, AISC Specification for Structural Steel Buildings.

1.6 QUALIFICATIONS

- A. Manufacturer: The Company manufacturing the products specified in this section shall have a minimum of five (5) years' experience in the manufacture of steel building systems.
- B. Structural framing and covering shall be the design of a licensed Professional Engineer experienced in design of this work.
- C. Erector shall have specialized experience in the erection of steel building systems for a period of at least five (5) years.

1.7 FIELD MEASUREMENTS

- A. Metal building contractor shall verify that field measurements are: as indicated in the contract documents and/or as indicated on the erection drawings and/or as instructed by the manufacturer.

1.8 WARRANTY

- A. Building manufacturer shall provide a material warranty of five (5) years, a weather-tightness warranty of 10 years and a color-fast warranty of 10 years.
- B. Metal building contractor shall provide a workmanship warranty of one (1) year.

1.9 ADMINISTRATION

- A. All nomenclature shall conform to the MBMA Metal Building Systems Manual.
- B. Coordination and administration of the work shall be in accordance with the MBMA Metal Building Systems Manual - Common Industry Practices.

PRODUCTS

2.1 MATERIALS - ROOF SYSTEM

- A. Sheet Steel Stock: Galvanized coated to G90.
- B. Roof Insulation: ASTM C665, semi-rigid batt blanket glass fiber type, faced with reinforced white vinyl, UL flame spread classification of 25 or less where exposed, 4 inches thick, with a minimum R-value of 13.

Important Note: The required insulation for this project may be established by the applicable energy code. If there is an applicable energy code, the metal building provider is responsible for verifying insulation requirements with applicable authorities to determine if additional thermal resistance rating is required to meet the proper code requirements.

- C. Standing Seam Roofing: Minimum 24 gauge profile, ASTM E1592 tested, UL 580, Class 90 uplift rating, mechanical seam joining sides, with factory applied sealant.
- D. Soffit Panels: Minimum 26 gauge 0.0179 inch metal thickness, unperforated, color as selected from manufacturer's standard colors.
- E. Closures: Manufacturer's standard type, closed cell or metal.
- F. Fasteners: Manufacturer's standard type. Size and design to maintain load and weather tightness requirements. Fasteners to be stainless steel cap with carbon shank self-drilling and tapping.
- G. Sealant: Manufacturer's standard type.
- H. Exterior Surfaces of Roof Panels: Galvalume
- I. Interior Surfaces of Roof Panels: Galvalume

2.2 MATERIALS - WALL SYSTEMS

- A. Sheet Steel Stock: Galvanized coated to G90.

Wall Insulation: ASTM C665, semi-rigid batt blanket glass fiber type, faced with reinforced white vinyl, UL flame spread classification of 25 or less where exposed, 3 inches thick, with a minimum R-value of 10.

Important Note: The required insulation for this project may be established by the applicable energy code. If there is an applicable energy code, the metal building provider is responsible for verifying insulation requirements with applicable authorities to determine if additional thermal resistance rating is required to meet the proper code requirements.

- B. Siding: Minimum 26 gauge, 0.0179 inch, R profile indicated, 3 inches deep, lapped edges.

- C. Closures: Manufacturer's standard type.
- D. Fasteners: Manufacturer's standard type. Size and design to maintain load and weather tightness requirements. Fasteners to be carbon steel, plated self-drilling and tapping.
- E. Exterior Surfaces of Wall Panels: Pre-coated steel of silicone polyester finish, color as selected from manufacturer's standard colors.
- F. Interior Surfaces of Wall Panels: Pre-coated steel with wash coat of polyester manufacturer's standard finish.

2.3 MATERIALS - TRIM

- A. Flashings, Internal and External Corners, Closure Pieces: Same material and finish as adjacent material, profile to suit system. Color as selected from manufacturer's standards.

2.4 MATERIALS - METAL PERSONNEL DOORS AND FRAMES

- A. Refer to contract documents for types of doors and frames required. Doors and frames shall be designed by their manufacturer to meet the wind load provisions as specified and energy code requirements as required.
- B. Building system manufacturer's standard door and frame type as shown on plan.

2.5 MATERIALS - DOORS AND FRAMES, OTHER THAN PERSONNEL

- A. Refer to contract documents for types of doors and frames required. Doors and frames shall be designed by their manufacturer to meet the wind load provisions as specified and energy code requirements as required.

2.6 MATERIALS - WINDOWS

- A. Refer to contract documents for types of windows required. Windows shall be designed by their manufacturer to meet the wind load provisions as specified and energy code requirements as required.
- B. Building systems manufacturer's standard window and frame type as shown on plans.

2.7 MATERIALS - TRANSLUCENT PANELS (if required)

- A. Translucent roof panels shall be clear or white translucent UL 90 rated panels capable of sustaining a 200 pound concentrated load on a one foot square located anywhere on the panel without rupture. Translucent panels shall be compatible with the steel roof panels, and shall meet the requirements of

Section 1.4C. Panel shall be 8 oz. per square foot and shall have a fire retardant rating of Local Code. The minimum visible light transmission shall be [60%] when measured in accordance with ASTM D1494.

- B. Translucent wall panels shall be white translucent panels and be compatible with the steel wall panels, and shall meet the requirements of Section 1.4C. The minimum visible light transmission shall be [60%] when measured in accordance with ASTM D1494.
- C. Provide framing for all openings.

2.8 FABRICATION - PRIMARY FRAMING

- A. Framing Members: Clean and prepare in accordance with SSPC-SP2 as a minimum, and coat with primer meeting SSPC No. 15. Note: Galvanizing may require further preparation.
- B. Hot rolled members shall be fabricated in accordance with AISC Specification for pipe, tube, and rolled structural shapes.
- C. Fabricate built-up members in accordance with MBMA Metal Building Systems Manual, Common Industry Practices.

2.9 FABRICATION - SECONDARY

- A. Framing Members: Clean and prepare in accordance with SSPC-SP2, as a minimum, and coat with primer meeting SSPC No. 15. Note: Galvanizing may require further preparation.
- B. Cold Formed Members: Cold formed structural shapes shall be fabricated in accordance with MBMA Metal Building Systems Manual, Common Industry Practices.

2.10 FABRICATION - GUTTERS, DOWNSPOUTS, FLASHINGS AND TRIM

- A. Fabricate gutters, flashings and trims from manufacturer's standard selection. Color to be selected from manufacturer's standard offering. Must coordinate with details.
- B. Fabricate or furnish downspouts with elbows from manufacturer's standard selection. Color to be selected from manufacturer's standard offering.
- C. Form gutters and downspouts (and scuppers) of profile and size required by Section 1.4 J to collect and remove water. Fabricate with connection pieces.
- D. Form flashing and trim sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- E. Fabricate or furnish gutter support straps of manufacturer's standard

material, design and finish.

- F. Fabricate or furnish downspout clips or support straps of manufacturer's standard material. Finish color as selected.

EXECUTION

3.1 EXECUTION

- A. Verify site conditions under provisions of Section 1.4.
- B. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position and properly squared.
- C. Provide access to the work as scheduled for owner provided inspections, if required. The cost of any required inspections is the responsibility of the owner.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 ERECTION - FRAMING

- A. Erect framing in accordance with MBMA Metal Building Systems Manual, Common Industry Practices.
- B. Use templates for accurate setting of anchor rods. When required, level bearing plate area with steel wedges, shims or grout. Check all previously placed anchorages.
- C. Erect building frame true and level with vertical members plumb and bracing properly installed. Maintain structural stability of frame during erection.
- D. Ream holes requiring enlargement to admit bolts. Burned holes for bolted connections are not permitted without written approval by designer. Burned holes to be reamed.
- E. Tighten bolts and nuts in accordance with "Specification for Structural Joints Using ASTM A325 or A490 Bolts" using specified procedure. Turn-of-the-nut tightening may be used to assure correct tightening.
- F. The erector shall furnish temporary guys and bracing where needed for squaring, plumbing, and securing the structural framing against loads, such as wind loads acting on the exposed framing and seismic forces, as well as loads due to erection and erection operation, but not including loads resulting from the performance of work by others. Bracing furnished by the manufacturer for the metal building system cannot be assumed to be adequate during erection and are not to be used to pull frames into plumb condition.

The temporary guys, braces, falseworks and cribbing are the property of the erector, and the erector shall remove them immediately upon completion of erection.

- G. Do not field cut or modify structural members without approval of the metal building manufacturer.
- H. After erection, erector to prime welds, abrasions, and surfaces not shop primed or needing touch-up.

3.3 ERECTION - WALL AND ROOFING SYSTEMS

- A. Install all wall and roofing systems in accordance with manufacturer's instructions and details.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, using proper fasteners aligned level and plumb.
- D. Set purlins and girts at right angle and bolt to appropriate clips. Attach to clips as required to satisfy design loads and as shown on drawings.
- E. Place screw down roof panels at right angle to purlins and girts. Attach and plumb wall panels as shown on drawings. Maintain consistent module coverage for entire length of wall. Predrill panels. Lap panel ends minimum of 3 inches on roof and 3 inches on walls. Place end laps over purlins or girts. Apply manufacturer's roof panel side and end lap sealant between panel ends and side laps to provide water-tight installation per details furnished.

3.4 ERECTION - GUTTER, DOWNSPOUT, FLASHINGS AND TRIM

- A. Install gutters and downspouts, flashings and trim in strict accordance with manufacturer's instructions, using proper sheet metal procedures.
- B. Install downspouts to utilize splash pads..

3.5 ERECTION - TRANSLUCENT PANELS

- A. The translucent panels to be installed in accordance with manufacturer's instructions and details.
- B. To be coordinated with installation of roofing and wall systems and related flashings and trims.
- C. The installation to be made weathertight by referring to details.

3.6 INSTALLATION - ACCESSORIES

- A. Install door frame, door, overhead door, window and glass, and in accordance with manufacturer's instructions.

- B. All roof and wall accessories to be installed weathertight.

3.7 TOLERANCES

- A. All work shall be performed by experienced workmen in a workmanlike manner to published tolerances.
- B. Install framing in accordance with MBMA Metal Building Systems Manual, Common Industry Practices.

SECTION 15010 - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor, etc., required to complete installation specified herein and/or shown or scheduled on Plans.

1.2 INSTRUCTIONS

- A. The General Conditions, Information to Bidders, Special Conditions, and other pertinent documents issued are a part of these specifications and shall be complied with in every respect.
- B. This Contractor shall examine the General Construction Plans, the Structural Plans and the Electrical Plans and lay out his work accordingly to avoid conflict.
- C. This Contractor shall visit the site in order to familiarize himself with existing working conditions. Failure to do so shall not relieve Contractor of responsibility of making changes required by conditions encountered on site.
- D. This Contractor shall conform to standards prescribed by City, County and State regulations or ordinances having jurisdiction. Any changes that may be necessary to conform to such regulations or ordinances shall be made by this Contractor without extra cost to the Owner.
- E. This Contractor shall provide all items, articles, materials, operations or methods listed, mentioned, or scheduled on the drawings and/or herein including all labor, materials, equipment and incidentals necessary, required or implied, for the completion of the various systems.
- F. Permits required for the installation of the work, as well as all authorized code inspections, including all fees, meters, and assessments, shall be borne by and arranged for by the Contractor.

1.3 DRAWINGS

- A. The drawings indicate the extent and general arrangement of the various systems. If any departure from these drawings is necessary, descriptions of these departures and a statement of the reasons therefor shall be submitted to the Engineer for approval.
- B. These Plans and Specifications shall be considered a part of this Contract. Should an error or omission occur in either the plans or the specifications, or conflict between the two, the Contractor shall not avail himself of such unintentional error, omission or conflict, but shall request same be explained to him and adjusted before signing the Contract or proceeding with the work. After that time the Engineer's resolution of the conflict shall be considered final. The Engineer extends no warranty on the documents to any person or entity other than the Owner identified in the Owner-Contractor agreement.
- C. Heating, plumbing, piping, and wiring plans being necessarily drawn to scale are diagrammatic only. They are intended to indicate capacity or size where stipulated, approximate location, direction and general arrangement of one phase to the other or to the general construction, but not the exact details or arrangement of construction. If, before installation of portions of any or all

construction phases, it is found that a more suitable, more workable or more convenient arrangement of any or all phases of the project would result by varying or altering the arrangement from that indicated on the drawings, it shall be done without additional cost to the Owner. Such re-arrangement shall be in accordance with directions from the Engineer or his representative.

- D. Concerning discrepancies discovered after certain portions of any contract have been installed, the Engineer reserves the right to require any or all Contractors to make minor changes in pipe, ducts, fixture or equipment locations or arrangements to avoid conflicts with other work at no additional cost to the Owner.
- E. Because the drawings are to a relatively small scale to show as large a portion as is practical, the fact that only certain features of the system are indicated does not mean that other similar features or details will not be required. Contractors shall furnish all incidental labor, material or equipment for the systems in their control so that each system is a complete and operating one unless otherwise specifically stipulated in the detailed body of the specifications.

1.4 LIST OF MATERIALS, FIXTURES AND EQUIPMENT

- A. **Within thirty (30) days after award of Contract, submit a complete list of materials, fixtures and equipment to the Engineer for approval. There shall be five (5) copies of data on each item and they shall be complete with names and addresses of manufacturers, catalog and model numbers, trade names, any options, capacities, and the Engineer's mark or symbol for that item all clearly marked on each data sheet. Electronic submission is acceptable, however, partial submittals will not be accepted. HVAC, Plumbing, and Fire Protection can be submitted separately as a complete submittal. Approval shall be based on manufacturer's published ratings only. Materials or equipment rejected shall be revised and re-submitted within thirty (30) days. Failure to comply with the above mentioned deadlines shall disallow any substitutions of materials or equipment. After two rejections of any item, the Contractor will be required to submit on that item exactly as specified.**
- B. **Submittals shall be bound in a three ring binder. There shall be an index clearly identifying each item being submitted. Each section shall be clearly tagged such that it corresponds to the index.**
- C. **Contractor shall not delegate the authority to material supply houses to present data for approval. This shall be done by the Contractor.**
- D. **Partial submittals will not be accepted. HVAC, Plumbing, and Fire Protection can be submitted separately as a complete submittal.**

1.5 SUBSTITUTIONS OF MATERIALS

- A. Where a definite material is specified, it is not the intent to discriminate against any product of another manufacturer. It is the intent to set a definite standard.
- B. Open competition is expected, but in all cases, complete data must be submitted on all proposed substitutions and samples shall be submitted for comparison and test when requested by the Engineer.
- C. Where three or more manufacturers or suppliers are listed for any given material, equipment, or

service the Engineer reserves the right to require the Contractor to provide material, equipment, or service from one of the named manufacturers or suppliers. Reference to a brand name, however, will not excuse that or any brand from compliance with all specified requirements. The Engineer expressly reserves the right to reject the use of unnamed material, equipment or services.

- D. The words "or equal", "equal to", etc., signify that the written approval of the Engineer must be obtained before any substitutions may be made for the items specified well in advance of the time when such items are needed. The Engineer's approval will not relieve the Contractor of responsibility for material, equipment or work later found to be defective or otherwise unsuitable for the work. The Engineer will not approve equipment prior to submittals submission after job is bid.
- E. It shall be the responsibility of this Contractor to ascertain if the substitute items will fit into the space allotted as conveniently as the items specified. Any changes to the building system or electrical design necessary shall be arranged for in writing before material is ordered. All costs involved in making such changes shall be borne by the Contractor. If such changes are deemed inadvisable by the Engineer, the Contractor shall install items specified even though substitute item had been previously approved. Engineer's approval of a substitute is for performance and/or design only.

1.6 STARTING AND INSTRUCTIONS

- A. All equipment and systems shall be tested as hereinafter specified or directed by the Engineer.
- B. Furnish a competent mechanic to supervise the starting, adjusting and testing of all equipment and to train the operator in the operation of the system. Where specified, certain major items of equipment shall be installed under the supervision of and tested by a specialist furnished by the manufacturer of the equipment. Such specialist shall train the operator in the use of his equipment.
- C. Furnish manufacturer's printed operating and maintenance instructions for equipment and systems. Mount operating instructions in approved frame with glass cover and locate where directed.

1.7 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Responsibility for care and protection of equipment and materials under this Contract rests with this Contractor until equipment or materials have been tested and accepted.
- B. All pipe ends, valves, and parts of equipment left unconnected, permanently or temporary, shall be capped, plugged or properly protected to prevent entry of foreign matter.

1.8 SERVICE AVAILABILITY

- A. The availability of service is of prime importance to the Owner and was a major consideration in selecting items as a basis for this specification. The Contractor is advised, therefore, to exercise caution in accepting prices in the "or equal" clause in this specification. The service agency, as a representative of this manufacturer, must have been in continuous operation in this area sufficient time to indicate a degree of permanence as required by the Engineer.

1.9 CODES AND STANDARDS

A. Applicable Codes

1. All work performed and all materials used shall conform to the standards as set up by the following codes:
 - a. ASME - Boiler and Pressure Vessel Code
 - b. National Electrical Code
 - c. International Plumbing Code
 - d. International Building Code
 - e. National Fire Codes - NFPA
 - f. ASHRAE Guide
 - g. SMACNA, Duct Construction Standards
 - h. Local City, County and State codes

1.10 ELECTRICAL REQUIREMENTS

A. General

1. All mechanical work performed under this Contract shall be in accordance with Division 16, Electrical Construction.
2. All motors under this Contract shall have thermal overload protection.
3. Motor starters required for manual or automatic control other than those shown in a motor control center or motor starter panel shall be furnished by mechanical contractor and installed by electrical contractor as directed. Manually controlled motors shall be provided with hand-off-automatic switches integral with the starter. All magnetic starters shall be provided with red running pilot light in cover and three-phase overload protection. Motor starters shall be Square D or approved equal.
4. Motor starters shall be furnished specifically for the following:
 - a. All three-phase motors.
 - b. All single-phase motors rated over 120 volts.
 - c. All single-phase motors rated 120 volts where interlocked with other motors or controlled devices.
5. Starters shall be enclosed in NEMA 1 enclosures when located indoors, NEMA 3R enclosures when located outdoors, and when located in hazardous or classified locations shall be enclosed in an enclosure rated for the specific type atmosphere expected to be present.
6. Power Connections (Line Voltage): For controlled circuits shall be furnished and installed from distribution or power panel to disconnect (safety) switch, starter and final connection to motor by Electrical Contractor.
7. Control circuit wiring required for interlocking starters and remote control of controlled devices, including conduit, wiring, boxes and final connections shall be the sole responsibility of the Mechanical Contractor. Where controlled interlocking of motor is required, all starters shall be furnished with two (2) normally open and one (1) normally closed auxiliary contacts. This shall include connections to Energy Management Panel.

PART 2 - PRODUCTS

Not applicable

PART 3 - EXECUTION

3.1 WORKMANSHIP, MATERIALS AND EQUIPMENT

- A. All work shall be performed in a workmanlike manner and shall present a neat and mechanical appearance when completed. All materials shall be of type, quality and minimum rating prescribed therein or indicated on the Plans.

3.2 PROTECTION OF WORK

- A. This CONTRACTOR shall protect his work at all times from danger by freezing, breakage, dirt, foreign materials, etc., and shall replace all work so damaged. The CONTRACTOR shall use every precaution to protect the work of others, and he will be held responsible for all damage to other work caused by his work or through the neglect of his workmen.

END OF SECTION

SECTION 15020 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor, etc., required to complete installation specified herein and/or shown or scheduled on Plans.

1.2 EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavate trenches for underground pipe lines to required depth and provide a separate trench for each utility sewer and water line except where otherwise noted on drawings. Lay all pipe in open trench unless noted otherwise on plans. Water lines shall be installed with a minimum of 24" cover unless otherwise approved by the Engineer.
- B. After piping has been tested, inspected and approved by the Engineer, and prior to backfilling, remove forms and clean excavation of trash and debris.

1.3 GENERAL PIPING INSTALLATIONS

- A. Arrange and install piping approximately as indicated, straight, plumb and as direct as possible; form right angles or parallel lines with building walls. Keep pipes close to walls, partitions, ceilings, offset only where necessary to follow walls as directed. Locate groups of pipes parallel to each other; space them at distance to permit applying full insulation and to permit access for servicing valves. The Engineer reserves the right to require this Contractor to make minor changes in pipe locations where conflicts occur with other trades or equipment. Such changes shall be made without extra cost to the Owner.
- B. Install horizontal piping as high as possible without sags or humps. Grade drainage piping at uniform slope of 1/4 inch per foot minimum. Where this is impossible, maintain slope as directed, but in no case less than 1/8 inch per foot.
- C. Locate valves for easy access and operation. Where concealed, provide access doors. Do not locate any valves with stems below horizontal.
- D. Provide water supply, drain, vent and gas connections to equipment specified in other Sections, requiring such services. Indicated locations and sizes of piping, valves, shall conform to approved shop drawings and printed installation directions furnished by equipment manufacturer. Connection sizes shall not be smaller than equipment outlets.
- E. Provide flanges or unions as applicable at all equipment connections. For steel and wrought iron pipe, use malleable iron unions 150 psi for standard pipe and 250 psi for extra heavy, with bronze to iron ground joints; cast iron flanged unions to be gasket type.
- F. Sufficient space shall be allowed in erecting piping for proper application of thermal insulations including fittings. In no case shall any insulation be cut or reduced in thickness because of inadequate space.
- G. If any piping is found installed without being reamed, cleaned, deburred, etc. or in any way

contrary to above, it shall be sufficient reason for related erected piping to be removed, inspected by the Engineer, corrected and reinstalled, all at contractor's expense.

- H. All piping to be of domestic (United States) manufacture and so certified by the Contractor.
- I. In the installation of all pipe runs where shown or where necessary, install expansion joints as specified or as necessary to allow for expansion. Broken pipe or fittings due to rigid connections must be removed and replaced at no additional cost to the Owner.
- J. All lines shall be securely anchored where required. Where such anchors occur, they shall be securely fastened to the structure of the building in a manner approved by the Engineer. Drawings shall be submitted before installation.
- K. Exposed piping passing through walls, floors and ceilings, shall be fitted with escutcheons. Inside diameter shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve.

1.4 FLASHING

- A. Vent pipes passing through roof shall be flashed with 4 pounds lead sheet, at least 20 inches square shall be extended up and turned down inside pipe with pipe at least 12 inches above roof at center line. Vents shall off-set in roof joist area if necessary so that no vent shall be closer than 4 feet from outside wall line.

1.5 BURIED PIPING

- A. Provide detectable metal core plastic backed tape manufactured specifically for warning and identification of buried piping over all exterior piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED OIL PIPING BELOW" or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

PART 2 PRODUCTS

Not applicable

PART 3 - EXECUTION

3.1 WORKMANSHIP, MATERIALS AND EQUIPMENT

- A. All work shall be performed in a workmanlike manner and shall present a neat and mechanical appearance when completed. All materials shall be of type, quality and minimum rating prescribed therein or indicated on the Plans.

3.2 PROTECTION OF WORK

- A. This CONTRACTOR shall protect his work at all times from danger by freezing, breakage, dirt, foreign materials, etc., and shall replace all work so damaged. The CONTRACTOR shall use every precaution to protect the work of others, and he will be held responsible for all damage to other work caused by his work or through the neglect of his workmen.

END OF SECTION

SECTION 15050 - PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor, etc., required to complete installation specified and/or shown or scheduled on plans.
- B. Piping shall be in accordance with the following standards:

ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fitting
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fitting
ANSI B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings
ANSI B31.5	Refrigeration Piping Errata
ASME/ANSI B16.5	Pipe Fitting and Pipe Flanges
ASME/ANSI B16.9	Factory Made Wrought Steel Butt Welding Fittings
ASME/ANSI B16.11	Forged Fittings, Socket Welded and Threaded
ASME/ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASTM B 32	Solder Metal
ASTM B 42	Seamless Copper Pipe, Standard Sizes
ASTM B 88	Seamless Copper Water Tube
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D2412	Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) PVC Sewer Pipe and Fittings
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
AWS A5.8	Filler Metals for Brazing

1.2 WORK INCLUDED

- A. Pipes, fittings, unions, couplings, flanges, gaskets, and other materials and instructions for the following piping systems.
 - 1. Sanitary waste and vent piping.
 - 2. Domestic water piping.
 - 3. Natural gas piping.
 - 4. Refrigerant piping.
 - 5. Equipment drains.

1.3 SUBMITTALS

- A. Provide submittal data showing product is in compliance with these specifications and the referenced industry standards.

- 1.4 All piping installed on this project shall be new and of full weight and size shown and of proper specification for service intended. Only domestic pipe may be used. When piping is cut, it shall be reamed with pipe reamer and all burrs, scale, trash and foreign matter removed. Where non-ferrous piping connects to ferrous piping, install EPCO dielectric couplings.

- 1.05 Where piping is threaded, dies shall be clean and sharp and joint compound shall be applied to male end only. All joints shall be made up tight. The caulking of these joints will not be tolerated. Pipe joint compound must be approved by the Engineer. Copper tubing may be cut with a tubing cutter or hacksaw with guide.

PART 2 - PRODUCTS

- 2.1 Provide the specified materials for the following piping systems:

- A. Sanitary Waste Below Grade and outside building:
 - 1. PVC pipe shall conform to ASTM D 3034, SDR 35. Jointing shall be accomplished by means of elastomeric gasket joints conforming to ASTM D 3212. Gasket materials shall be suitable for use with domestic sewage and shall conform to ASTM F 477. Pipe shall be installed in accordance with ASTM D 2321.
- B. Sanitary Waste and Vent Piping System inside building
 - 1. Sanitary waste below grade and inside shall be Schedule 40 PVC in accordance with ASTM D3034.
- C. Domestic water piping system outside building
 - 1. Domestic water piping below grade and outside of building shall be Type "K" copper in accordance with ASTM B88. Fittings shall be ANSI B16.18 or ANSI B16.22 soldered joint in accordance with SBCCI 88.

D. Domestic Water Piping System Inside Building

1. Domestic water piping within the building shall be Type "L" copper in accordance with ASTM B88 with ANSI B16.18 or ANSI B16.22 soldered joint fittings or with ASME/ANSI B16.26 flared joint fittings. Provide ASTM B42 copper pipe nipples with threaded end connections. Provide ASTM B32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder.

E. Natural gas piping system inside building.

1. Natural gas piping above grade and inside building shall be Schedule 40 black steel in accordance with ASTM A53. Piping inside return air plenums or above roof shall be welded. Pipe greater than two inches (2") diameter shall be welded. All other pipe less than two inches (2") diameter may have screwed joints.

F. Refrigerant Piping

1. Refrigerant piping shall be seamless copper tubing, hard drawn, type "L" in accordance with ASTM B88. Fittings for copper tubing shall be wrought copper or bronze, brazing joint type ANSI B16.18 or ANSI B16.22. Copper flared type tubing may be made only in annealed copper tubing ASTM B280 and in nominal sizes smaller than one-inch only for connection to equipment and no larger than 1-3/8 inches diameter for other connections. Flanges shall be of bronze ANSI B16.24.

G. Equipment Drain Piping

1. Equipment condensate drain shall be Schedule 40 PVC.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All piping installed on this project shall be new and of full weight and size shown and of proper specification for service intended. Only domestic pipe may be used. When piping is cut, it shall be reamed with pipe reamer and all burrs, scale, trash and foreign matter removed. Where non-ferrous piping connects to ferrous piping, install EPCO dielectric couplings.
- B. Where piping is threaded, dies shall be clean and sharp and joint compound shall be applied to male end only. All joints shall be made up tight. The caulking of these joints will not be tolerated. Pipe joint compound must be approved by the Engineer. Copper tubing may be cut with a tubing cutter or hacksaw with guide.
- C. Copper tubing shall be thoroughly reamed, cleaned with steel wool or emery cloth, and a non-corrosive flux used before soldering or brazing. Where soldered joints in domestic water piping are specified, only antimony and lead free solder shall be used. Where brazed joints are specified, only copper-phosphorous alloys shall be used. Where unavoidable soldered joints occur below slab on grade, silver solder with minimum 5% silver content shall be used.

3.2 STENCILING ON PIPING

- A. All piping exposed or concealed shall have the following symbols stenciled on pipe in a visible location. Stencil shall be attached to pipe every twenty feet (20'). Stencil shall be installed after piping has been painted and/or insulated. Stencil legend shall be as follows:

<u>Service:</u>	<u>Symbol:</u>
Sanitary waste and vent	San W.
Domestic cold water	DCW
Domestic hot water	DHW
Natural Gas	Gas

B. Install "Direction of Flow" arrow at each stencil.

3.3 Painting of Piping and/or Pipe Insulation

- A. After insulation and before stenciling, piping in the following locations shall be painted by the General Contractor with appropriate direction from the Mechanical Contractor:
1. All piping in equipment rooms.
 2. All other exposed piping indoors.

END OF SECTION

SECTION 15060 - VALVES

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor, etc., required to complete installation as specified herein and/or shown or scheduled on plans.
- B. This section includes the installation of all valves.
- C. Valves shall be in accordance with the following industry standards:

MSS SP-69	Pipe Hangers and Supports - Selection and Application
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	Steel Pipe Unions Socket-Welding and Threaded

D. Submittals

- 1. Provide submittal data showing product is in compliance with these specifications and the referenced industry standards.
- 2. Valves shall have name or trademark of manufacturer and working pressure cast or stamped on valve body.
- 3. Valve handwheels shall be oriented when installed to provide maximum accessibility for operation.
- 4. Valve discs shall be the manufacturer's standard material for the service in which the valve is used unless otherwise indicated under the individual type valve specification.
- 5. Each valve in the following indicated piping systems, shall have valve tag, minimum 1-1/4" size, 18 gauge brass, affixed assigning a number to the valve, except valve tags are not required on steam trap assemblies. Designation numbers shall be stamped in tags. Tags shall be as follows:

<u>System</u>	<u>Tag Shape</u>	<u>Typical Designations</u>
Natural Gas	Octagonal	NG-1, NG-2

Brass tags shall be attached to valves with nylon self-locking cable ties. A valve chart framed under glass and wall mounted shall be provided, which shall list each valve by number, its location in the piping system (including pipe line such as CH or CHR, and associated piece of equipment such as pump or chiller), and its function (shut-off, balancing, drain or quick-fill). Valve chart shall be mounted in the Mechanical Room or where directed by Engineer.

PART 2 - PRODUCTS

2.1 Provide full port ball valves for the following piping systems:

A. Domestic water

- 1. Ball valves two inches (2") diameter or less:
 - a. Nibco S-850 or T-580 or equal

2.2 Provide check valves for the following systems:

A. Domestic water

1. Swing check type, 2 inch diameter or less:
 - a. Valves shall be bronze, swing type in accordance with MIL-V-18436.
Valves shall be rated for 125# SWP. Valves shall be:
Nibco S-413-Bq Stockham B-309
Milwaukee 1509 Crane 1342

2.3 Valves for Natural Gas System

- A. Plug Valves. Valves shall be iron-body (semi-steel) lubricated, with teflon coated plug. Flanged valves shall be installed between 150# ASA steel flat faced slip-on weld flanges. Valves over 1" size shall be wrench operated and wrench shall be furnished with each size valve. Each plug valve shall be serviced with the sealant recommended by the valve manufacturer.
1. Valves 2" and smaller shall be short-pattern type with threaded end connections. Valves shall be rated at 175# WOG. Valves shall be:
Nordstrom Fig. 142 Walworth No. 655
Powell No. 2200

2.4 Copper Pipe

- A. Models indicated in this Section are for steel pipe. If copper service is indicated, Contractor shall supply a valve of the same type specified, but for copper pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Valves shall be installed in accordance with manufacturer's recommendations.
- B. Install at equipment and as indicated on drawings to allow maintenance or isolation, and to establish proper and sequential operation of complete system. Shell and tube liquid coolers shall have fluid valves installed so that tubes are accessible for cleaning or replacing. Provide globe valves or plug cocks where required to regulate flow to obtain equal distribution of gas or fluid handled. Remove valve bonnets, where valve construction permits removal, when connecting valves by brazing to copper tubing. Install globe and angle valves with stems horizontal where necessary to avoid trapping of fluid.

END OF SECTION

SECTION 15080 - MECHANICAL SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. Provide supporting devices for mechanical systems as described herein.
- B. Isolators shall be in accordance with the following industry standards:

ASTM D 2240 Rubber Property - Durometer Hardness

ARI 370 Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment

ARI 575 Measuring Machinery Sound Within an Equipment Space

- C. Submittals

- 1. Provide submittal data showing product is in compliance with these specifications and the referenced industry standards.

1.2 PIPE HANGERS

- A. All horizontal pipe are to be supported by adjustable hangers supported below structure. Use Fee and Mason 239, Grinnell, or Midland-Ross. Use Fee and Mason Figure 81, Grinnell or Midland-Ross protectors on all insulated pipe and install hangers on outside of insulation.
- B. Where piping is grouped in parallel horizontal runs at same elevation, or as otherwise noted on plans, bar-type supports may be used using Fee and Mason Figure 8005, Grinnell, or Midland-Ross hangers or Unistrut channels.
- C. All vertical risers shall be supported at the floor by Fee and Mason Figure 241, Grinnell, or Midland-Ross riser clamps in addition to adequate base supports.
- D. Hangers are to be installed not more than ten feet (10') apart on 1-1/2 inch and larger pipe and not more than eight feet (8') apart on pipe smaller than 1-1/2 inches.

1.3 FOUNDATIONS AND EQUIPMENT SUPPORTS

- A. This Contractor shall provide suitable foundations and supports, as indicated on drawings, specified herein, or as required to make a neat, substantial and workmanlike job. All foundations, supports, stands, etc., shall be approved by the Architect/Engineer prior to construction.
- B. The condensing units shall be placed on minimum four-inch (4") deep chamfered edge concrete foundations. Dimensions of slab shall be slightly greater than the unit being supported. Provide #4 reinforcement bars 12" on center both ways in the middle of all foundations.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All electrical connections, drain connections, piping connections, etc., made to equipment which resets on vibration isolators, shall be sufficiently flexible to permit the equipment to be properly isolated.
- B. Submittal data on vibration isolators shall be included with submittal data on each piece of equipment.

2.2 FLEXIBLE CONNECTIONS

- A. Flexible connections shall be installed on each piece of equipment as indicated on Plans.
- B. Flexible connections shall be of the metallic type. Metal hose shall be Grade E phosphor bronze, monel or stainless steel corrugated tube covered with comparable bronze or stainless braid restraining and pressure cover. Stainless steel grades shall be 304, 316 or 321 as required for the application. Length of flexible metal hose shall be not less than that recommended by the manufacturer for continuous vibration application.
- C. Flexible connections shall be installed in accordance with the manufacturer's recommendations, including placement in the pipe line without damage, misalignment or change in its normal length. Prior to filling the system, the alignment and length shall be checked by loosening the flange bolts to determine the installation conditions. The piping installation shall be corrected if necessary and the flexible hose replaced if damaged. As Vibration Mounting and Controls, Inc., Type MFE.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support equipment as specified herein.
- B. Provide isolators for equipment and piping systems as specified herein.
- C. Install isolators, materials and equipment as per manufacturer's directions.

END OF SECTION

SECTION 15160 - MECHANICAL SYSTEMS INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor, etc., required to complete installation specified herein and/or shown or scheduled on Plans.
- B. Field applied insulation for thermal efficiency and condensation control for HVAC piping, ductwork and equipment.
- C. Industry Standards
- D. Insulation systems shall be in accordance with the following industry standards:

ASTM C 195	Mineral Fiber Thermal Insulating Cement
ASTM C 916	Adhesives for Duct Thermal Insulation
ASTM C 1136	Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM E 84	Surface Burning Characteristics of Building Materials
ASTM E 96	Water Vapor Transmission of Materials
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilation Systems
NFPA 255	Surface Burning Characteristics of Building Materials
IBC	International Building Code
UL 723	Surface Burning Characteristics of Building Materials
- E. Submittals: Provide submittal data showing product is in compliance with these specifications and the referenced industry standards.

1.2 GENERAL

- A. Insulation shall include all insulating materials, their application, re-canvassing after finish, bands, tie wire, and weather protection for all pipe fittings, valve and equipment as indicated and as specified herein.
- B. Insulation and insulation assemblies shall meet the requirements of International Building Code (IBC), unless more stringent requirements are listed herein.
- C. Concealed insulation shall have a flame spread of 0-75 and a smoke developed of 0-450.
- D. Exposed insulation shall have a flame spread of 0-50 and a smoke developed of 0-450.

- E. Scope of Insulation: All new piping as indicated below, or where indicated on plans, details or schematics and all existing piping as noted shall be insulated. All piping system components exposed and subject to freezing shall be insulated. This includes valves, expansion joints, orifices, etc. Where gauge cocks, orifice ports and other similar devices require access, such devices shall have extensions beyond insulation provided by mechanical contractor.
- F. If a material specified herein becomes unavailable, or if there is a question regarding the required insulating material on this job, insulator shall advise engineer BEFORE job bids for resolution of the question.
- G. PVC jackets for insulation shall be in accordance with UL 723 and pertinent flame spread and smoke developed ratings.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

- A. Domestic Water Piping
 - 1. All above grade domestic cold and hot water piping shall be insulated. Piping shall be insulated as follows:
 - a. One inch (1") thick heavy density UL listed fiberglass insulation with factory supplied vapor barrier jacketing. Jacketing shall have continuous pressure sealing lap adhesive for sealing of the longitudinal joint. Butt strips shall be sized to seal each circumferential joint. Jacket shall have vapor permeance not greater than 0.02 perm/in. Fittings shall be insulated with 1" precut fiberglass and molded snap on type PVC jacket cover having a 25/50 flame/smoke rating. Seal edges of snap-on cover.
- B. Condensate Drains:
 - 1. One-half inch (1/2") thick closed cell elastomeric thermal insulation. The insulation shall be pre-slit longitudinally and pressure-sensitive adhesive for closure and vapor sealing of the longitudinal joint. Insulation shall have flame spread and smoke developed rating as established by ASTM E84.

2.2 DUCT INSULATION

- A. All ductwork shall be insulated on the exterior as follows:
 - 1. All ductwork shall be wrapped with blanket flexible mineral fiber conforming to ASTM 553, Type 1, Class B-3, 1.0 pounds per cubic foot, 2.0 inches thick.
 - 2. The insulation shall be stapled in place and all joints sealed as per manufacturer's directions. A copy of said directions shall be furnished to the Engineer with shop drawings on insulation.
 - 3. Duct dimensions indicated are actual metal sizes prior to installation of exterior insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All insulation shall be installed in accordance with manufacturer's written instructions.

- B. All above insulation shall be applied by a approved insulating Contractor employing trained insulating personnel.
- C. No insulation shall be applied over pipes, fittings or other surfaces which are not clean. Insulation shall be applied after pipes have been thoroughly tested and proven tight by the Mechanical Contractor.
- D. Insulation shall fit in snug contact with pipe and be installed in accordance with Manufacturer's recommendations.
- E. Stagger joints on layered insulation.
- F. Seal joints in insulation.
- G. Provide six inch long, 20 gauge galvanized steel sleeve around pipe insulation at each support.
- H. Insulate fittings with sheet insulation and as recommended by Manufacturer where no other fitting insulation is indicated above.

END OF SECTION

SECTION 15260 - FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section shall include furnishing and installing all materials for the complete installation of the following:
Wet Pipe Sprinkler System zoned as shown on FP drawings.
and shall apply to all phases of work specified, shown on the drawings or reasonably required to provide for the complete installation of approved fire protection systems for the project. The warehouse is classed as fully sprinklered.

- B. Fire protection system shall be in accordance with the following industry standards:
AWWA C110 Ductile Iron and Gray Iron Fittings, 3 inch thru 48 inch, for Water and other Liquids

AWWA C151 Ductile Iron Pipe, Centrifugally Cast, for Water and other Liquids

AWWA C651 Disinfecting Water Mains

NFPA 13 Installation of Sprinkler Systems

NFPA 24 Installation of Private Fire Service Mains and Their Appurtenances

NFPA 70 National Electrical Code

IBC International Building Code

UL FPED Fire Protection Equipment Directory

UL 262 Gate Valves for Fire-Protection Service

UL 789 Indicator Posts for Fire-Protection Service

1.2 GENERAL

- A. The contractor for the fire protection installation shall be a NICET III Certified, qualified Fire Protection Contractor, and regularly engaged in the installation of Automatic Fire Sprinkler Systems and other Fire Protection Equipment.
- B. All materials, equipment valves and devices installed and/or furnished under this section shall be listed and/or approved for use in the fire protection installation by the authorities, agencies, codes and standards named in this section of the specifications.
- C. Refer to: Underwriters' Laboratories Approved Fire Protection Equipment List.
- D. Any permits for the installation or construction of any of the work included in this section which are required by any of the authorities and/or agencies having jurisdiction shall be obtained and paid for by the Fire Protection Contractor.

1.3 SYSTEM DESIGN

- A. Design automatic wet pipe sprinkler system in accordance with NFPA 13 the required and advisory provisions of NFPA 13, by hydraulic calculations for uniform distribution of water over the design area. Pipe sizes indicated on the drawings are shown to illustrate a sample system. Actual pipe sizes shall be determined by hydraulic calculation. Pipe sizes which are shown as minimum sizes may be increased in size but should not be decreased.

Warehouse – the warehouse and any storage rooms or offices within the warehouse shall be classified as CMSA Class I and II for palletized storage.

1.4 GUARANTEE

- A. The entire fire protection installation, as specified under this section of the specifications, shall be guaranteed for one (1) year against defective equipment, materials and workmanship. The guarantee period is to begin on the date of acceptance of the project by the Owner.
- B. The guarantee shall not be construed as requiring the Fire Protection Contractor to render service or maintenance required in the normal operation of the equipment, or to make repairs that may be needed due to normal wear and tear or the Owner's negligence, abuse, or breakage.

1.5 EXISTING MAIN PRESSURES AT SITE

- A. Pressure readings shall be acquired by the Contractor.
- B. The actual locations of mains, branch mains and sprinkler heads should be coordinated with other trades and shall meet all Code requirements.
- C. The locations shown for items such as standpipes with hose valves, control valves, zone boundaries, etc., have been coordinated with the architectural and mechanical requirements, any deviations from the locations shown for this equipment should be verified.

1.6 SUBMITTALS

- A. Hydraulic calculations
- B. Manufacturer's Catalog Data
 - 1. Pipe and fittings
 - 2. Alarm valves/riser check valves
 - 3. Valves, including gate, check and globe
 - 4. Water motor alarms
 - 5. Sprinkler heads
 - 6. Pipe hangers and supports
 - 7. Pressure or flow switch
 - 8. Fire department connections
 - 9. Mechanical couplings
- C. Shop drawings

1. Sprinkler heads and piping system layout
2. Electrical wiring diagrams
 - a. Sprinkler Heads and Piping System Layout: Prepare 24- by 36-inch detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)." Show data essential for proper installation of each system. Show details, plan view, elevations, and sections of the systems supply and piping. Show piping schematic of systems supply, devices, valves, pipe, and fittings. These drawings shall have reviewed, approved and stamped by the appropriate fire department prior to submission to Engineer.

1.7 SYSTEMS

- A. For each system provide flow switch, control valve, riser check valve with main drain and pressure gauges. Switches shall be fully compatible with fire alarm system.
- B. A standard installation of automatic sprinklers arranged as a wet pipe system should be installed as required by the computerized hydraulic analysis.
- C. Provide drains at all trapped locations exceeding 5 gallons. On far mains on typical zones provide 1" globe valves on bottom of main for auxiliary drains.
- D. Connection to the water supply system shall be made where indicated on the drawings.
- E. The water piping, valving, sprinkling equipment and hose connections shall be installed complete in all respects.

PART 2 - PRODUCTS

- 2.1 ABOVEGROUND PIPING SYSTEMS: Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings; bushings will not be permitted. Perform welding in the shop; field welding will not be permitted. Conceal piping in areas with suspended ceiling and exposed in mechanical room.
 - A. Sprinkler Pipe and Fittings: NFPA 13, except as modified herein. Steel piping shall be Schedule 40. Fittings into which sprinkler heads, sprinkler head riser nipples, or drop nipples are threaded shall be welded, threaded, or grooved-end type. Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into the pipe when pressure is applied will not be permitted. Rubber gasketed grooved-end pipe and fittings with mechanical couplings shall be permitted in pipe sizes 1.5 inches and larger. Fittings shall be UL FPED listed for use in wet pipe sprinkler systems. Fittings, mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer. Steel piping with wall thickness less than Schedule 30 shall not be threaded. Side outlet tees using rubber gasket fittings shall not be permitted. Piping less than Sch 10 shall not be permitted.
 - B. Cabinet: Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. The number and types of extra sprinkler heads shall be as specified in NFPA 13.

2.2 ALARMS

- A. For each system provide and install a 120 volt bell (wiring by electrical contractor) at the riser to be mounted on the exterior wall.

2.3 UNDERGROUND FIRE LINE / SITE FIRE PROTECTION

- A. Contractor shall connect fire protection main to existing water main as indicated on Civil Plans.
- B. Underground pipe and fittings shall be listed in:
 - 1. Underwriters' Laboratories - Approved Fire Protection Equipment List and shall be in accordance with AWWA C151.
- C. Underground pipe shall be C900, as required by the authorities having jurisdiction.
- D. Underground fittings shall have joints and pressure class rating compatible with the pipe used.
- E. All underground piping for fire mains shall be installed, clamped and anchored, flushed, and hydrostatically tested. Underground test and flushing certificates shall be completed and submitted. If the underground piping/site fire protection is installed by a different contractor than the inside fire sprinkler contractor these certificates will be furnished to the inside fire sprinkler contractor.

2.4 VALVE PIT

- A. Valve pits shall be furnished and constructed by the site Fire Protection Contractor as shown on the drawings.

2.5 PROTECTION OF EXISTING UTILITIES

- A. Existing utilities that are shown on the drawings or locations of which is made known prior to excavation shall be protected from damage during the excavation and backfilling of trenches, and if damaged, shall be repaired promptly by the Contractor at his expense.
- B. Any existing utility that is not shown on the drawings or the location of which is not known in sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired promptly by the Contractor. In any event, repair shall be made under the supervision of the utility concerned.

2.6 FIRE DEPARTMENT HOSE CONNECTIONS

- A. The fire department hose connection shall be provided. Threads on connection shall match local Fire Department threads.
- B. Connection shall be plain finished with "AUTO SPKR" branded on top.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to

bear evenly on hangers and supports. Do not hang piping from plaster ceilings. Keep the interior and ends of new piping and existing piping affected by Contractor's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. Inspect piping before placing into position.

- B. Electrical Work: Provide electrical work associated with this section under Section 16, "Interior Wiring Systems," except for control and fire alarm wiring. Provide fire alarm system under "Interior Fire Alarm System." Provide control and fire alarm wiring, including connections to fire alarm systems, under this section in accordance with NFPA 70. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.
- C. Disinfection: Disinfect the new water piping affected by Contractor's operations in accordance with AWWA C651. Exercise caution when mixing chlorine disinfectant solutions. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit results prior to new water piping being placed into service. Disinfection of system supplied by nonpotable water is not required.
- D. Connections to Existing Water Supply Systems: Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around the main piping; bolt valve to the branch connection. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, all without interruption of service. Notify the Engineer in writing at least 15 days prior to connection date; receive approval before any service is interrupted. Furnish materials required to make connections into existing water supply systems, and perform excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to existing systems.
- E. Tests: Hydrostatically test each system at 200 psig for a 2-hour period with no leakage or reduction in pressure. Flush piping with potable water in accordance with NFPA 13. Piping above suspended ceilings shall be tested, inspected, and approved before installation of ceilings. Test the alarms and other devices. Test the water flow alarms by flowing water through the inspector's test connection. When tests have been completed and corrections made, submit a signed and dated certificate, similar to the specified in NFPA 13.
- F. Guarantee: The entire fire protection installation, as specified under this section of the specifications, shall be guaranteed for one (1) year against defective equipment, materials and workmanship. The guarantee period is to begin on the date of acceptance of the project by the Owner.
- G. The guarantee shall not be construed as requiring the Fire Protection Contractor to render service or maintenance required in the normal operation of the equipment, or to make repairs that may be needed due to normal wear and tear or the Owner's negligence, abuse, or breakage.

END OF SECTION

SECTION 15300 - PLUMBING FIXTURES, TRIM & ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor, etc., required to complete installation specified herein and/or shown or scheduled on Plans.
- B. Work Included: Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.
- C. Plumbing fixtures, trim and accessories shall be in accordance with the following industry standards:

ANSI A112.36.2M	Cleanouts
ASME A112.6.1M	Supports for the Off-the-floor Plumbing Fixtures - Public Use
ASME A112.18.1M	Plumbing Fixture Fittings
ASME/ANSI A112.19.1M	Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	Vitreous China Plumbing Fixtures
ASME A112.19.5	Trim for Water-Closet Bowls, Tanks, Urinals
ASME A112.21.1M	Floor Drains
PDI WH 201	Water Hammer Arrestors
IPC	International Plumbing Code

1.2 GENERAL

- A. All fixtures must be securely fastened to the floor or walls by means of inserts or expansion bolts in concrete work, and by means of expansion bolts, toggle bolts in masonry work, and by means of framing and screws in frame construction, to the satisfaction of the Architect/Engineer. Plumber shall install fixtures in accordance with standard industry practice and manufacturer's instructions. Plumber shall seal around counter mounted fixtures to provide positive seepage protection.
- B. All plumbing fixtures shall be provided complete with all necessary trim including bolt caps, tail pieces and drains, blank off caps, etc., such that the fixtures are fully functional and aesthetically complete, whether or not all such parts are specifically listed in the specifications below. All porcelain or vitreous china fixtures (and related trim) shall be furnished in white color unless otherwise noted.

1.3 FIXTURE TRIM

- A. All plumbing fixture brass trim shall be so designed that all wearing parts are to be in a standardized renewable operating unit which can be removed without detaching the supply fixture or faucet proper. The standardized renewable operating units are to be interchangeable with all supply fixtures and faucets whether quick compression or self-closing. All exposed metal parts of all fixtures, including faucets, waste fittings, waste plugs, strainers, flush valves, traps, supplies, nipples and escutcheons shall be chrome plated brass unless other materials or finish is specified. Angle stops with S.P.S. brass nipples from wall to stops shall be provided on all water supplies to fixtures. Fixture trim must be that of the fixture manufacturer wherever possible and must bear a permanent impression of the manufacturer. No "competitive grade" trim will be permitted. All tubular waste pipe and fittings under sinks and lavatories shall be 17 gauge chrome plated brass. All p-traps shall have cleanout plugs.
- B. SUBMITTALS: Provide submittal data showing product is in compliance with these specifications and the referenced industry standards.

PART 2 - PRODUCTS

- 2.1 Furnish and install all plumbing fixtures as shown on Plans. Kohler fixtures are specified, however, Crane, Eljer, or American Standard may be used if they are equal in all respects to those specified. Contractor shall submit data on trim on well as fixtures. Where Zurn flush valves are specified, equivalent Delaney models will be the only permitted substitute.
 - A. Cleanouts

General: Furnish all cleanouts and/or test tees as shown on Plans and required by Code. Cleanouts shall be the same size as the pipe they serve, except that 4 inches shall be the largest size required. Cleanouts shall be provided at the foot of each soil stack and of each run, change in direction, and mains, not to exceed 50 feet apart inside of building and 100 feet apart outside of building. Cleanouts shall be as manufactured by Wade, Jay R. Smith, Zurn, or Josam, and shall be as follows:

 1. Inside building- Zurn Model ZN 1400 NH.
 - B. Water Hammer Arresters
 1. All water supply piping fittings and fixtures shall be protected against water hammer, shock or surge pressure by water hammer arresters. Arresters shall incorporate metal piston. The following schedule for Zurn or Precision Plumbing Products, arresters shall apply:

<u>P.D.I. Symbol</u>	<u>Fixture Unit Ratings</u>
A	1-11
 2. Fixture piping shall be adequately anchored to prevent vibration.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures, trim and accessories shall be installed in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 15760 - EXHAUST FANS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor required to complete the installation of exhaust fans shown on drawings and specified herein.
- B. Exhaust fans shall be in accordance with the following industry standards:

AMCA 210	Testing Fans for Rating
AMCA 300	Certified Sound Ratings Program for Air Moving Devices
NEMA MG1	Motors and Generators
NFPA 90A	Installation of Air Conditioning and Ventilation Systems
SMACNA DCSHVAC	Duct Construction Standards - Metal and Flexible
UL 507	Electric Fans

PART 2 - PRODUCTS

2.1 ABOVE CEILING EXHAUST FAN

- A. Fan shall be mounted above ceiling and vent routed through wall to weatherproof wall louver as shown on plans. Fan shall have forward curved wheel constructed of aluminum. Fan motor shall be of the shaded pole type. Housing shall be of steel construction with baked enamel finish. Fan shall have plug type disconnect. Fan shall have integral backdraft damper.
- B. Capacity and characteristics as indicated.
- C. As Cook Model specified, or approved equal.

2.2 PROPELLER FAN

- A. Propeller fan shall be of the belt driven type. Fan panel shall be of steel construction with spun venturi. Propeller blades shall be die formed and welded to steel hub assembly. Fan drive system shall be attached to fan panel to provide a rigid support system. Fan shall be complete with guard. Fan shall have coating for protection against salt air.
- B. Size and capacity shall be as indicated on Plans. Fans shall be AMCA certified.
- C. Fan shall be complete with louver having blades which close when fan is not in operation. Louver blades shall be of aluminum or galvanized steel painted.
- D. Fan shall have unit mounted disconnect switch.

PART 3 - EXECUTION

3.1 PREPARATION

Provide storage for equipment and materials at the project site. Parts shall be readily accessible for inspection, repair, and renewal. Protect materials and equipment from weather.

3.2 FANS

Install with resilient mountings, flexible electrical leads, and flexible connections between fan inlet and discharge ductwork. Provide fixed sheaves required for final air balance and safety screen where inlet or outlet is exposed.

3.3 FIELD QUALITY CONTROL

- A. Schedule and administer specified tests. Provide personnel, instruments, and equipment for such tests. Correct defects and repeat the respective inspection and tests. Give the Contracting Officer ample notice of the dates and times scheduled for tests and trial operations. Conduct inspection and testing in the presence of the Contracting Officer.
- B. Inspection: Prior to initial operation, inspect equipment installation for conformance with drawings and specifications.

3.4 TESTING AND BALANCING

Test and balance each exhaust system in accordance with Section 15940, "Testing and Balancing."

END OF SECTION

SECTION 15820 - PACKAGED AIR CONDITIONING AND HEATING EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor required to complete the installation of packaged air conditioning and heating equipment.
- B. Work Included: Packaged air conditioning and heating equipment shall include:
 - 1. Split systems with gas furnaces
- C. Packaged air conditioning and heating equipment shall be in accordance with the following industry standards:

ARI DCUAC	Directory of Certified Unitary Air Conditioning Equipment
ARI 410	Forced Circulation Air-Cooling and Air Heating Coils
ASHRAE 15	Safety Code for Mechanical Refrigeration
ASHRAE 52	Equipment Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASME/ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B31.5	Refrigeration Piping
ASTM B 280	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM F 872	Filter Units, Air Conditioning: Viscous- Impingement Type
ASTM F 1040	Filter Units, Air Conditioning: Viscous- Impingement and Dry Types, Replaceable
AWS A5.8	Specifications for Filler Metals for Brazing and Braze Welding
MSS SP-58	Pipe Hangers and Supports, Materials, Design and Manufacture
MSS SP-69	Pipe Hangers and Supports Selection and Application
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
UL 873	Temperature Indicating and Regulating Equipment
UL 900	Air Filter Units

1.2 SUBMITTALS

- A. Manufacturer's Catalog Data.

PART 2 - PRODUCTS

2.1 NATURAL GAS FURNACES

- A. Furnaces shall be of the natural gas fired, horizontal type, complete with filters, centrifugal blower and motor, burners, heat exchangers, control and cabinet. Furnace shall be in accordance with AGA Z21.47. Furnaces shall be 90% efficient.
- B. Filters shall be 1" thick disposable type
- C. Blower shall have forward curved blades, statically and dynamically balanced. Motor shall be of the three speed type, complete with built-in overload protection.
- D. Controls shall consist of manual shut-off gas valve, spark ignition pilot gas valve, transformer, combination fan and limit switch control and power induced draft blower. Thermostat shall be provided with the furnace.
- E. Furnace cabinet shall be thermally and acoustically insulated.
- F. Furnace shall have capacities as listed on plans.

2.2 EVAPORATOR COIL

- A. Coil shall be sized to fit warm air furnace described above. Coil shall have copper tubes and aluminum fins. An insulated casing shall be provided around coil.
- B. Capacity and characteristics shall be as indicated on Plans.
- C. As Trane Model indicated, or equal.

2.3 CONDENSING UNIT

- A. Unit shall consist of compressor, condenser fan and controls enclosed in weatherproof casing.
- B. Casing shall be of galvanized steel construction, primed and finished in baked enamel.
- C. Compressor shall be of the hermetic type with motor located within refrigerant flow pattern resulting in low motor winding temperature. Twin internally mounted motor in-winding temperature sensing thermostats and a discharge gas temperature sensing thermostat shall provide safe operation of compressor. Compressor shall have spring loaded discharge valve, high suction intake ports and crankcase heater shall result in effective "slugging" protection. High and low pressure controls shall be provided and factory installed in compressor terminal box. High and low pressure reset shall be automatic. In addition, a low ambient cut-out thermostat shall prevent compressor operation below 22 degrees F.

- D. Condenser coil shall be constructed with copper tubes and aluminum fins, pressure tested to assure against leakage.
- E. Condenser fans shall be of the propeller type and shall be of aluminum construction.
- F. Unit capacity and characteristics shall be as indicated on Plans. Unit shall be rated in accordance with ARI Standard 240.
- G. A five year compressor warranty shall be provided.

2.4 REFRIGERANT PIPING SYSTEMS

- A. Material and dimensional requirements for field-assembled refrigerant piping, valves, fittings, and accessories shall conform to ASHRAE 15 and ASME/ANSI B31.5, except as herein specified. Factory clean, dehydrate, and seal piping before delivery to the project location. Provide seamless copper tubing, hard drawn, Type "L", conforming to ASTM B88, except that tubing with outside diameters of ¼ inch and 3/8 inch shall have nominal wall thickness of not less than 0.30-inch and 0.032-inch, respectively. Soft annealed copper tubing conforming to ASTM B 280 may be used where flare connections to equipment are required only in nominal sizes less than one inch outside diameter.
- B. ASME/ANSI B16.22 for solder-joint fittings, for flared tube fittings.

2.5 CONTROLS

- A. All units shall have wall mounted thermostats of the seven day programmable type to match existing thermostats in the existing building. Unit shall have heat-cool and off-on-auto fan selections. Unit shall have battery backup to save programming in case of power outage. Remote sensors shall be provided where shown on drawings.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Install equipment and components in a manner to ensure proper and sequential operation of equipment and equipment controls. Install equipment not covered in this section, or in manufacturer's instructions, as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supports, vibration isolators, stands, guides, anchors, clamps and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise indicated. Set anchor bolts and sleeves using templates. Provide anchor bolts of adequate length, and provide with welded-on plates on the head end embedded in the concrete. Level equipment bases, using jacks or steel wedges, and neatly grout-in with a nonshrinking type of grouting mortar. Locate equipment to allow working space for servicing including shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.

- B. Unitary Air Conditioning System: Install as indicated, In accordance with requirements of ASHRAE 15, and the manufacturer's installation and operational instructions. System shall be in accordance with NFPA 90A.
- C. Room Air Conditioners: Install units in accordance with manufacturer's instructions and provided with structural mountings, panels, and seals for weathertight assembly. Pitch unit as recommended by manufacturer to ensure condensate drain to drain pan without overflow.

3.2 PIPING

- A. Brazing, bending, forming and assembly of refrigerant piping shall conform to ASME/ANSI 831.5. Pipe Hangers and Supports: Design and fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP-58. Installation of hanger types and supports for bare and covered pipes shall conform to MSS SP69 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58.
- B. Refrigerant Piping: Cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Install piping to be insulated with sufficient clearance to permit application of insulation. install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping plumb and straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure. Braze refrigerant piping with silver solder complying with AWS A5.8. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with energy cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air. Make provisions to automatically return oil on halocarbon systems. Installation of piping shall comply with ASME/ANSI 831.5.
- C. Returning Oil from Refrigerant System: Install refrigerant lines so that gas velocity in the evaporator suction line is sufficient to move oil along with gas to the compressor. Where equipment location requires vertical risers, line shall be sized to maintain sufficient velocity to lift oil at minimum system loading. Larger riser shall have a trap, of minimum volume, obtained by use of 90- and 45-degree elbows. Arrange small riser with inlet close to bottom of horizontal line, and connected to top of upper horizontal line. Do not install valves in risers.
- D. Refrigerant Driers, Sight Glass Indicators, and Strainers: Provide refrigerant driers, sight glass liquid indicators, and strainers in refrigerant piping in accordance with specifications, when not furnished by the manufacturer as part of the equipment. Install driers in liquid line with service valves and valved bypass line the same size as liquid line in which dryer is installed. Size of driers shall be determined by piping and installation of the unit on location. Install dryers of 50 cubic inches and larger vertically with the cover for removing cartridge at the bottom. Install moisture indicators in the liquid line downstream of the drier. Indicator connections shall be the same size as the liquid line in which it is installed.
- E. Strainer Locations and Installation: Locate strainers close to equipment they are to protect. Provide a strainer in common refrigerant liquid supply to two or more thermal valves in parallel

when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on drainer's body.

- F. Solenoid Installation: Install solenoid valves in horizontal lines with stem vertical and with flow in direction indicated on valve. If not incorporated as integral part of the valve, provide a strainer upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

3.3 AUXILIARY DRAIN PANS, DRAIN CONNECTIONS, AND DRAIN LINES

- A. Provide auxiliary drain pans under units located above finished ceilings or over mechanical or electrical equipment where condensate overflow will cause damage to ceilings, piping, and equipment below. Provide separate drain lines for the unit drain and auxiliary drain pans.

3.4 AIR FILTERS

- A. Allow access space for servicing filters. Install filters with suitable sealing to prevent bypassing of air. Filters shall be the 1" pleated type.

3.05 IDENTIFICATION TAGS AND PLATES

- A. Provide equipment, gauges, thermometers, valves, and controllers with tags numbered and stamped for their use. Provide plates and tags of brass or suitable nonferrous material, securely mounted or attached. Provide minimum letter and numeral size of 1/8 inch high.

3.06 FIELD QUALITY CONTROL

- A. Leak Testing: Upon completion of installation of air conditioning equipment, test factory- and field-installed refrigerant piping with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ASHRAE 15, except that test pressure shall not exceed 150 psig on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks, and retest system.
- B. Evacuation, Dehydration, and Charging: After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gauge and a vacuum pump capable of pulling a vacuum of at least one mm Hg absolute. Evacuate system in accordance with the triple-evacuation and blotter method or in accordance with equipment manufacturer's printed instructions.

END OF SECTION

SECTION 15860 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor required to complete the installation of ductwork systems shown on the drawings and specified herein.
- B. Work included: Ductwork systems shall include the following types of systems:
 - 1. Low velocity supply, return and exhaust air systems.
 - 2. Flexible supply air systems.
- C. Ductwork systems shall be in accordance with the following industry standards:

AMCA 500	Louvers, Dampers and Shutters
AMCA 501	Application Manual for Air Louvers
ASTM A 527/A 527M	Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock-Forming Quality
ASTM C 423	Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM E 96	Water Vapor Transmission of Materials
NFPA 90A	Installation of Air Conditioning and Ventilating Systems
SMACNA DCS	HVAC Duct Construction Standards - Metal and Flexible
UL 181	Factory-Made Air Ducts and Air Connectors
UL 555	Fire Dampers

D. SUBMITTALS

- 1. Manufacturer's Catalog Data
 - a. Dampers
 - b. Flexible ducts and connectors
 - c. Diffusers, registers, and grilles
 - d. Metal ducts

PART 2 - PRODUCTS

2.1 LOW VELOCITY RECTANGULAR DUCTWORK

- A. Steel Ducts: ASTM A 527/A 527M galvanized steel sheet, lock-forming quality; coating designation G90. Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA DCS, except that ducts with pressure classifications below 2 inch water gage that are located outside of the conditioned space shall have a seal class C. Ductwork shall be

airtight and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork with pressure classifications above one inch water.

- B. All necessary allowances and provisions shall be made for beams, columns, pipes, conduits, iron work or other obstructions in the construction of the building or the work of other contractors, whether or not the same is shown on these drawings. Where necessary to avoid beams or other structural systems, piping or conduit, the Contractor shall divide or curve ductwork to avoid said systems. Ductwork when divided shall maintain the same cross-sectional areas in accordance with the latest edition of the ASHRAE Guide.

- C. Gauges of galvanized steel shall be as follows:

1. **LOW PRESSURE DUCTWORK**

<u>Maximum Size</u> <u>Inches</u>	<u>Steel</u> <u>Gauge</u>	<u>Bracing</u>
Up to 12"	26	S slip, drive slip, 1 inch pocket lock on 8 ft. centers
13" - 18"	24	S slip, drive slip, 2 inch pocket lock on 8 ft. centers
19" - 30"	24	S slip, 1" pocket lock on 8' centers with 1x1x1/8" angles 4' from joint.
31" - 42"	22	Longitudinal standing seam, 1" standing S cleat, bar slip, or pocket lock on 4' centers with 1x1x1/8" angles 4' from joint.
43" - 54"	22	Longitudinal standing seam inside 1-1/2" standing S
55" - 60"	20	Cleat, bar slip, pocket lock on 8' centers with 1-1/2 x 1-1/2 x 1/8" angles 4' from joint.

- D. Turning vanes shall be installed at each elbow and change in direction of supply duct where shown. Turning vanes shall be a true airfoil design; smoothly rounded entry nose with extending trailing edge. Generated sound power level shall not exceed 54 dB in the third octave band at 2000 fpm duct velocity. Vane spacing shall be 2.4 inches on center across the full diagonal dimension of the elbow. Vanes shall be as manufactured by Aero/Dyne Co., High Efficiency Profile model with factory side rails, or approved equal.
- E. Ductwork shall be connected to air handling devices supply return and outdoor air connections by flexible connectors. Connector shall be Dura-Dyne Type DPN or approved equal waterproof and fireproof fabric. Flexible connections shall be at least five inches (5") long and securely fastened with galvanized band iron hoops.
- F. Hard Cast DT-Tape with FTA-20 adhesive shall be applied to each duct joint and point of attachment of duct hanger. Samples shall be submitted to the Engineer for approval.

2.2 **LOW VELOCITY ROUND DUCTWORK**

- A. All necessary allowances and provisions shall be made for beams, columns, pipes, conduits, iron work or other obstructions in the construction of the building or the work of other contractors, whether or not the same is shown on these drawings. Where necessary to avoid beams or other structural systems, piping or conduit, the Contractor shall divide or curve ductwork to avoid said systems. Ductwork when divided shall maintain the same cross-sectional areas in accordance with the latest edition of the ASHRAE Guide.

- B. Gauges of galvanized steel shall be as follows:

1. LOW PRESSURE DUCTWORK

Maximum Size <u>Inches</u>	Steel <u>Gauge</u>
Up to 8"	28
9" - 14"	26
15" - 26"	24
27" - 36"	22
37" - 50"	20

2. Ductwork shall be longitudinal seam, snap lock type, with aluminized duct tape applied over entire length of longitudinal and circumferential seams. Ductwork shall be externally insulated.

C. Furnish and install manually operated volume control dampers in all branches, splits, or at all supply air, return air, exhaust or transfer openings where necessary for proper balancing of air distribution. Dampers shall be of single blade type. Dampers shall have a quadrant type indicating device with lock to hold damper in position for proper setting. Damper shall be as Ruskin CDRS-25.

2.3 FLEXIBLE DUCTS

A. Flexible ductwork shall be constructed in accordance with UL 181, Class 1, SMACNA DCS and additional requirements herein specified. Provide to connect between rigid ductwork and air diffusion devices. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream.

B. Flexible ductwork shall be satisfactory for operating pressure up to 6 inches water gauge.

C. Insulated flexible ductwork shall be constructed with aluminized mylar laminated to a corrosion resistant steel wire helix. Duct shall be insulated with one inch (1") thickness of fiberglass insulation having a density of 1 lb./cu. ft. Sheathe insulation with a vapor barrier having a maximum water vapor permeance of 0.20 perm in accordance with ASTM E96, Procedure A. Coat ends of insulation with cement to prevent erosion and delamination.

D. Maximum length of flexible ductwork shall not exceed 6'-0".

E. Flexible ducts shall be suspended on 36 inch centers with a minimum 3/4 inch wide flat banding material. All joints and connections shall be made with 1/2 inch wide positive locking steel straps.

2.4 CASINGS AND PLENUMS

A. Factory fabricated components with field installation. Furnish certified testing data from plenum or casing manufacturer obtainable directly from an independent acoustical laboratory, listing sound absorption and transmission loss characteristics of panel assembly. Sound absorption coefficients and sound transmission loss, determined by an independent laboratory, shall be in accordance with ASTM C 423 and ASTM E 90 respectively.

2.5 DAMPERS

A. Furnish and install manually operated volume control dampers in all branches, splits or at all supply air, return air, exhaust or transfer openings where necessary for proper balancing of air

distribution. Dampers shall be of single blade type. Dampers shall have a quadrant type indicating device with lock to hold damper in position for proper setting. Damper shall be as Ruskin CDRS-25.

2.6 DIFFUSERS, REGISTERS, AND GRILLES

- A. Material and Finishes: Provide factory-furnished diffusers, registers, and grilles constructed of aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Colors shall be selected by Owner.
- B. Sound Pressure Level: Manufacturer certified sound pressure level ratings of inlets and outlets. Conform with the following permissible room sound pressure levels:

NC Range, dB	Typical Application
30 - 35	Office or Laboratory Area
- C. Throw: The distance from the diffuser, register or grille to the point which the air velocity falls below 50 feet per minute shall not exceed 1.5 times the outlet mounting height.
- D. Drop: Maximum drop of air stream shall not be within 5 feet of the floor at the end of the throw.
- E. Ceiling Diffusers: Equip with baffles or other devices required to provide proper air distribution pattern as indicated. Provide factory-fabricated, single key, volume dampers. Except for linear diffusers, internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.
- F. Square Diffusers: Construct each ceiling diffuser of four or more concentric elements designed to deliver air in a generally horizontal direction without excess smudging of the ceiling. Interior elements of square and rectangular ceiling diffusers may be circular, square, or rectangular as manufacturer's standard.
- G. Return Air and Exhaust Air Grilles
 - 1. Ceiling Type Grilles
 - a. Grilles shall be 1/2" by 1/2" grid opening of aluminum construction. Grille shall be surface mounted. Grille shall be white finish. Size and capacity shall be as indicated on Plans.

2.7 DUCT SLEEVES, PREPARED OPENINGS, AND CLOSURE COLLARS

- A. Duct Sleeves: Fabricate from minimum 20-gauge galvanized steel. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated. Size sleeves to provide one-inch clearance between duct and sleeve or between insulation and sleeve for insulated ducts.
- B. Prepared Openings: Provide one-inch clearance between the duct and the sleeve, or one-inch clearance between insulation and sleeve for insulated ducts except at grilles, registers, and diffusers.
- C. Packing: ASTM C553, Type 1, Class B-2, mineral fiber.
- D. Closure Collars: Four inches wide minimum, fabricated from minimum 20 gauge galvanized steel.
 - 1. Sizes and capacities shall be as indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

Conform to NFPA 90A and SMACNA DCS. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Provide electrical isolation between dissimilar metals. Electrical isolation may be fluorinated elastomers or sponge-rubber gaskets. Install ductwork accessories as indicated and as recommended by manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service. Louvers in accordance with AMCA 501.

- A. Ductwork: Air distribution systems shall operate with no chatter or vibration.
1. Field Changes to Ductwork: Those required to suite the sizes of factory-fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts. Provide jumper ducts for discharging air into duct junctions as indicated.
 2. Dampers: When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.
 3. Access Doors: Provide for automatic dampers, volume dampers, fire dampers, coils, thermostats, temperature controllers, valves, filters, humidifiers and other concealed apparatus requiring service and inspection in the duct systems.
 4. Duct Sleeves, Prepared Openings, and Closure Collars: Provide for ductwork penetrations in floors, walls, and partitions through which metallic ductwork passes.
 - a. Duct Sleeves: Fill space between duct and sleeve or between insulation and sleeve for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.
 - b. Prepared Openings: Fill space between duct and opening or between insulation and opening for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.
 - c. Closure Collars: Fit collars snugly around ducts or insulation. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier. Provide nails with maximum 6-inch centers on collars.
- B. Ductwork Hangers and Supports: Ductwork hangers and supports shall be in accordance with SMACNA DCS, Section 4. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing.
1. Flexible Ducts: Support ducts by hangers every 3 feet, unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations and long radius elbows. Provide minimum length to make connections.
 2. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type drawbands. For rectangular ducts, lock flexible connectors to metal collars.
 3. Inspection Plates and Test Holes: Provide, where required, in ductwork or casings for all

- balance measurements. If possible, test holes should be located at least 7.5 times diameters downstream from a disturbance. Extend cap through insulation.
4. Flashing: Provide waterproof flashing where ducts pass through exterior walls or roofs.
 5. Cleaning of Ducts: Remove all debris and dirt from ducts and wipe clean. Before installing air outlets, force air through entire system at maximum attainable velocity to remove accumulated dust. Provide temporary air filters to protect ductwork which may be harmed by excessive dirt. For large systems, clean duct with high power vacuum machines.

3.2 FIELD QUALITY CONTROL

Administer and direct tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Notify Contracting Officer 14 days before inspection or testing is scheduled. Correct defects in work. Repeat tests until work is in compliance.

3.3 TESTING AND BALANCING

Perform testing and balancing on ductwork systems in accordance with Section 15940.

END OF SECTION

SECTION 15940 - TESTING AND BALANCING

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all material, equipment and labor required to test and balance all mechanical systems.
- B. Test and Balance Agency Credentials: Test and Balance Agency shall hold current membership in the Associated Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). Test and Balance Agency shall have completed at least five jobs of comparable size and similarity to this project. Test and Balance Agency job list, credentials and procedures shall be submitted with shop drawings by Mechanical Contractor for approval by Engineer. Test and Balance Agency shall have at least one registered professional engineer on staff and all reports shall bear the stamp of said engineer from the state in which this job is located. Said engineer's license in this state shall be current at the time reports are sealed.
- C. Balance procedures required herein shall be accomplished in accordance with ASHRAE HVAC Applications Handbook. Requirements therein shall be as binding as though full reprinted herein. Test and Balance Agency shall be completely familiar with the requirements of the ASHRAE HVAC Applications Handbook. Requirements therein shall be as binding as though full reprinted herein. Test and Balance Agency shall be completely familiar with the requirements and shall perform each task listed therein on the required systems. As a minimum, report shall include items required by "Report and Report Information", plus information on hydronic systems necessary to determine proper conformance to design requirements, including motor design and operating amps, and system flows and pressure drops:
- D. Procedures required on this job shall be:
 - Air Side Balancing
 - Temperature Control Verification
 - Vibration Testing
- E. Instrumentation used by agency shall be in calibration at time of testing. Required instruments shall be as listed in Chapter 34 as a minimum. Accuracy of instruments shall conform to the following list:

Temperature Indicators	± 0.1 degrees F max
Air Flow Indicators	± 10% max
Differential Pressure Gauges	± 5% max
Ampere Meters	± 3% max

PART 2 - BALANCING OF SYSTEMS

2.1 JOB INSPECTION

- A. Testing and Balancing Agency shall act as an authorized inspection agency, responsible to the Engineer, and shall list all items which require correction or have not been installed in accordance with contract drawings and/or specifications pertaining to heating, ventilating and air conditioning systems.

- B. The Testing and Balancing Agency shall be given access to the project site at all times and shall not be required to make prior arrangements with the contractor for site visiting to perform any balancing work or pre-balancing inspection the Agency may require.

2.2 AIR BALANCE

- A. Actual air balancing shall not begin until all systems have been completed, placed into operation, final filters installed, and all control systems completed and calibrated.
- B. Air balance shall include performance ratings of all supply, return and exhaust fan motors. Fan speeds shall be adjusted to provide design flows, including system diversities, at actual system pressures. Any drive changes necessary to meet this requirement shall be provided by the fan manufacturer and installed by the mechanical contractor under the direct supervision of the Testing and Balancing Agency at no additional cost to the Owner.
- C. Pitot Tube traverses of all trunk lines and major branch lines shall be made to determine proper proportioning of air flows within all systems.
- D. Pressure drop readings across all major system components and significant drops within duct systems shall be reported to determine any deviation between actual and theoretical value.
- E. Accurate flow and pressure measurements shall be made at each terminal device and each supply, return, or exhaust diffuser. Flow at terminal units and outlets shall be adjusted by appropriate means to within 10% of design requirements.
- F. Outside air, return air, and supply air quantities for all systems shall be adjusted to within 10% of design requirements.

2.3 CONTROL SYSTEMS

- A. The Mechanical Contractor shall have installed and thoroughly checked the action and calibration of all control devices and placed the entire system into operation.
- B. Testing and Balancing Agency shall thoroughly re-check all control sequences, and calibration of all control devices. Mechanical Contractor shall cooperate with Testing and Balancing Agency in the re-calibration of set-point readjustment of any control device he may require.

2.4 VIBRATION TESTING

- A. Testing and Balancing Agency shall make a visual inspection of all fans and air handling units for defects which cause excessive vibration when unit is operating.
- B. Vibration isolation on equipment shall be checked for equal deflection and proper operation.
- C. Testing and Balancing Agency shall measure the vibration of each unit with a vibration meter capable of frequency and amplitude analysis, including displacement and velocity readouts. Vibration shall be checked against ASHRAE HVAC Applications Handbook. If vibration exceeds amount listed therein, mechanical contractor shall take corrective action.

- D. A complete frequency analysis shall be made in areas where vibration amplitude measurements exceed those specified, in order to determine the cause of the excessive vibration.

2.5 OWNER INSTRUCTION

- A. Testing and Balancing Agency shall provide neatly typed final reports listing results of all air balancing as well as vibration and energy projection measurements and conclusion. Final reports shall be submitted to Architect/Engineer for his approval.

PART 3 - EXECUTION

3.1 SCHEDULING

- A. Contractor shall notify Testing and Balancing Agency immediately upon receipt of contract, the approximate completion date of project.
- B. Contractor shall give two weeks prior notice to Agency for testing and balancing schedule.
- C. Contractor shall operate all equipment during each day of testing and balancing as requested by Testing and Balancing Agency.
- D. Contractor shall allow sufficient time in completion schedule for testing and balancing.

3.2 COOPERATION

- A. Cooperation among all involved parties is essential to expedite completion of final testing and balancing. Contractor shall be responsible for coordinating all jobsite meetings between testing and balancing personnel and various sub-contractors and equipment suppliers. Building will not be turned over to the owner until final testing and balancing reports have been submitted to the engineer and approved.
- B. Contractor shall furnish and install through fan manufacturer, any additional drive change recommended by Testing and Balancing Agency, at no additional cost to the Owner.
- C. Contractor shall install necessary dampers and gauge connections as recommended by Testing and Balancing Agency to achieve proper balance.
- D. Contractor shall install all final filters before final air balancing begins.
- E. Contractor shall supply to Testing and Balancing Agency one copy of approved submittal data, including accurate performance data for all submitted equipment and one copy of final mechanical drawings and approved control drawings upon receipt of contract.
- F. It is the expressed responsibility of the Testing and Balancing Agency to carry out all procedures described within these specifications in a professional manner.
- G. It is the responsibility of the Testing and Balancing Agency to locate and identify all current and potential problem areas within the scope of these specifications and to initiate action by responsible parties to remedy such problems during the testing and balancing period. Test and Balancing Agency shall fully cooperate with the owner and Engineer to alleviate problem areas

by system adjustment to the full extent that the system is adjustable.

- H. Testing and Balancing Agency shall release no reports until such have been approved by the Engineer.

3.3 COMPLETION OF WORK

- A. Testing and Balancing Agency shall inform contractor as to the extent of completion of all testing and balancing requirements listed within these specifications.

3.4 ACCEPTANCE

- A. Installation shall not be considered complete until final testing and balancing reports have been submitted to consulting engineer and have been approved by him. One copy of all final reports shall be given to the Owner's representative after final approval by the Consulting Engineer.

3.5 WARRANTY

- A. Testing and Balancing Agency shall include an extended warranty of three (3) months, after submission of report during which time the engineer or owner may request a recheck or resetting of any item included in the report. Should it be found that the system has not been properly and completely balanced, the warranty period will be extended until the engineer is completely satisfied.

END OF SECTION

SECTION 15960 - PROJECT CLOSE OUT

PART 1 - GENERAL

1.1 TESTS

- A. This Contractor shall conduct such tests as required to determine that systems and equipment which he installs conform to Specifications. Contractor shall supply all labor, materials, instruments, operations, etc., required to facilitate testing. Gauges, thermostats, and instruments used in testing shall be accurate, recently calibrated and approved by the Engineer prior to test. Instruments installed permanently in systems as specified hereinbefore may be used in testing when approved by the Engineer. Engineer shall be notified when tests are to take place. If Engineer is not notified, Engineer may require test to be repeated. Tests shall be as follows:
1. Sanitary waste and vent: Minimum 10 feet hydrostatic test and as required by International Building Code.
 2. Relief Valves: Operate equipment until safety valves relieve. Record temperature and/or pressure at time of opening.
 3. Upon completion of the various systems, this Contractor shall set and adjust all valves, dampers, controllers, thermostats, etc.
 4. Each and every phase of the heating and ventilating system shall be operated for a sufficient period of time to demonstrate to the entire satisfaction of the Engineer, the ability of the system to meet the capacity and performance requirements.
 5. Gas piping must stand a pressure of at least 10 psi, but never less than twice the maximum pressure to which the piping will be subjected in operation, for a period of not less than 10 minutes without showing any drop in pressure.

1.2 OPERATING INSTRUCTIONS

- A. All equipment and systems shall be tested as hereinbefore specified.
- B. Furnish a competent mechanic to supervise the starting, adjusting and testing of all equipment and to train the operator in the operation of the system. Where specified, certain major items of equipment shall be installed under the supervision of and tested by a specialist furnished by the manufacturer of the equipment. Such specialist shall train the operator in the use of his equipment.
- C. Contractor shall furnish three (3) copies of operating and maintenance instructions for each and every piece of equipment supplied by him together with four (4) copies of spare parts lists. Information to be neatly bound in three ring binders, indexed, and labeled for each piece of equipment. Contractor will spend sufficient time with the operator to acquaint him with the complete operations of the system. Provide framed, glass enclosed, typewritten instructions, easily read, explaining exactly the procedure to be followed in starting up, and in shutting down the systems for each of the various control cycles. Operators, such as switches, pushbuttons, changeovers, etc., shall be numbered and referred to by number and function in the operating instructions. The manuals shall be transmitted to Physical Plant at least one month prior to the completion of the work. Also, the names and addresses of all subcontractors shall be listed in the front of the manual.

1.3 RECORD DRAWINGS

- A. This Contractor will be given two sets of blue line prints by the Architect/Engineer. Indicate all variations in running of pipe, location of drains, cleanouts, equipment, etc., from that shown on original plans in red pencil. These blue line prints shall be turned over to the Architect/Engineer upon completion of the job.
- B. Owner shall be furnished computer discs of CADD drawings and specifications if Owner agrees to pay for said services.

1.4 GUARANTEE

- A. The Contractor shall guarantee that these systems, when turned over to the Owner, have been installed in accordance with these Plans and Specifications. He shall also guarantee to keep all work embraced in these specifications in repair and proper working order without charge, for a period of one (1) year from date of acceptance of the work, except from damage by conditions beyond his control.

END OF SECTION

SECTION 16010

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 GOVERNING CLAUSE

The phrase "CONTRACTOR shall furnish and install" unless specified or indicated otherwise, shall be omitted for the sake of brevity in these specifications. However, these phrases are implied. Any mention of material and/or operations in the specifications or drawings will require CONTRACTOR to furnish and install such materials and perform each and every operation required for a complete and operable system and to the complete satisfaction of the ENGINEER. The drawings are diagrammatic and may not necessarily show each and every wire, conduit, conduit routing, junction electrical box and/or final connection required for all pieces of equipment. However, the intent of this paragraph is to require that the CONTRACTOR furnish labor and materials to make all required final electrical power connections whether or not shown to all equipment shown on the drawings issued as bidding documents for this project.

1.02 GENERAL CONDITIONS

- A. General Conditions, Supplementary General Conditions, Information to Bidders, General Requirements, Special Conditions, Addenda, Wage Rates, and other pertinent documents issued under these specifications shall be complied with in every respect as though fully written herein.
- B. Notwithstanding any reference in the specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall be interpreted as establishing a standard of quality and performance and shall not be construed as limiting competition; and in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the final judgment of the ENGINEER expressed in writing, is an approved equal to that specified.

1.03 RECORD DRAWINGS AND OPERATING AND MAINTENANCE MANUALS

Furnish to the ENGINEER at job acceptance and completion, the following in compliance with Section 01720:

- A. Record Drawings: One set of blue line prints marked in black, showing an accurate location of all variations of the work actually installed related to the original drawings. The drawings shall include all approved and installed Change Orders, field condition changes, and other variations from the original plans and specifications.
- B. Operation and Maintenance Manuals: Furnish three copies of an operation and maintenance manual for each electrical system and for each piece of equipment. Three copies of the complete manuals bound in a 3" - 3 ring black binder with color coded tabs as directed by the ENGINEER labeling all shop drawings, approved manufacturers brochures, control diagrams,

maintenance instructions and other data required by the contract documents reflecting the record fabrication and installation of all systems or equipment installed. One manual shall be furnished prior to the time that the system or equipment tests are performed. The remaining two manuals shall be furnished to the ENGINEER before the contract is closed-out.

- C. The following identification shall be inscribed in minimum 3/4" high alphabet type letters on the outside front corner: The words "OPERATING AND MAINTENANCE MANUAL", the name and location of the project and the contract number. The manual shall include the names, addresses, and telephone number of each subcontractor installing equipment and systems, and the local manufacturer's representative for each item of equipment and each system. This information shall be contained on the first page of the binder. Lettering shall be permanent signage and not stick-on type.
- D. The manual shall have a typewritten table of contents with the tab sheets placed before instructions covering the subject. The instruction sheets shall be legible with large sheets of drawings folded in. The manual shall include a system layout showing circuits, devices, and controls; control diagrams with explanation of operation and control of each component; start-up control sequence, and operation; a detailed description of the function of each principal component of the system; the procedure for starting; the procedure for operating; shut-down instructions; installation instructions, maintenance and overhaul instructions; lubrication schedule including type, grade, illustrations; test procedures; performance data; and parts list. The parts list for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the site. The manual shall be complete in all respects for all equipment, controls, and accessories provided.

1.04 TESTS AND INSPECTIONS

The complete job shall be, during actual construction, and for the warranty provision period, subject to the supervision of the ENGINEER and will have the following tests and inspections conducted without any additional cost to the contract.

- A. By ENGINEER'S inspections and tests conducted by him or for him in his presence. Upon written notice, CONTRACTOR shall furnish not to exceed two men, one to include the job foreman and tools to assist and be directed by the ENGINEER for a reasonable amount of time to make such tests and inspections as are requested by the ENGINEER pertaining to the safety and operation of any device or system installed.
- B. By complete insulation break-down tests with a megger of each and every branch circuit, and service entrance. All 600 volt conductors shall meet a minimum of resistance of 1,000,000 OHMS. Tests shall be performed prior to any connections to overcurrent devices, devices or equipment. All readings shall be made in the ENGINEER'S presence or his authorized representative and a type-written report of same submitted to him before the job is subject to his approval. The manufacturer, cat. no. and type or megger shall be noted on the report.
- C. By any federal, state or local authority having jurisdiction of the project.

-
- D. By the Kansas State Rating Bureau. After inspection by this agency, corrections of any deficiencies shall be made which were found adversely affecting the insurance to be carried by the OWNER. Acceptance of the Rating Bureau's report or subsequent reports lie with the ENGINEER or OWNER. Electrical contractor/subcontractor shall pay all cost for this work.
 - E. Properly phase out the entire electrical system to balance all loads as close as possible.
 - F. Certified Test Reports: Before any equipment or materials are delivered to the project site, certified copies of all test reports specified in the individual sections of this specification shall be submitted to the ENGINEER for his approval.

1.05 GUARANTEE

- A. Guarantee to the OWNER all work performed and all equipment installed under this contract shall be free from defects in workmanship and materials for a period of one year unless noted otherwise from date of final written acceptance by the ENGINEER and the OWNER.
- B. Defects shall be corrected arising during this one year period at the CONTRACTOR'S own expense, upon written notice of the OWNER or his authorized representative.

1.06 GENERAL INFORMATION

- A. Plans are diagrammatic. Judgment and care shall be exercised to install all electrical work in a practical manner which shall function properly and fit the construction and finishes. Electrical devices not shown or specified which shall be required or any device or system to produce a complete and operative system shall be brought to the ENGINEER'S attention at least five days prior to the bid date in order for such devices to be noted or clarified in an addendum, otherwise furnished at his own expense.
- B. Cooperate with others in laying out work so that the electrical phase of the work will properly fit the construction and finishes. Space requirements, etc. other than that shown on the plans required to facilitate the electrical construction, shall be brought to the ENGINEER'S attention prior to commencing any work so that proper action may be taken to remedy this.
- C. Exact location of equipment shall be determined on the job. **Do not scale electrical drawings for exact location of any equipment.** All mounting heights shall be verified prior to rough-in.
- D. ENGINEER reserves the right to change the location of any equipment improperly installed and to change the exact location of any equipment connection location up to twenty feet prior to rough-in with no additional cost to the contract.
- E. Circuit grouping, conduit or cable runs are indicated diagrammatically with number of conductors shown in each raceway to clarify the operation and function of various systems. Provide the proper number of conductors and conduits or cables to produce an operative system as specified herein. Where conductors are not shown, consult manufacturer's recommendations.

Branch circuit shall be indicated as 2 or 3 wire circuits unless otherwise noted. No two ungrounded conductors will be connected to the same ungrounded main in any panel. There shall be no splicing of branch circuit conductors in any panel, safety switch or non-automatic circuit breaker in separate enclosures.

- F. All materials shall be new (unless otherwise noted on the drawings or specified herein) and of approved equal or superior quality to those specified. All equipment or materials shall conform to the latest requirements of Underwriter's Laboratories, National Electrical Code, National, State or local agency having jurisdiction, American National Standards Institute (ANSI), National Electrical Safety Code and National Fire Protection (NFPA) Codes.
- G. All conductors shall be color coded as specified herein. All conductors not complying with the specified color code shall be removed and replaced solely at the electrical subcontractor's expense.
- H. All materials, devices, equipment, etc. shall be installed, tested and connected in strict compliance with manufacturer's recommendations.
- I. Install all materials, equipment, devices, etc. in a neat and workmanlike manner. Use only experienced labor or employ appropriate subcontractor to do all cutting and patching necessary for the installation of his materials.
- J. Protect from damage all apparatus and equipment furnished on this project. Equipment and materials shall be properly stored and adequately protected and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored and protected in accordance with the manufacturer's recommendations and as approved by the ENGINEER. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Plastic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Any piece of equipment or material marred or damaged shall be repaired, repainted and/or replaced to the complete satisfaction of the ENGINEER.
- K. Any piece of equipment, switch, device, etc. shown mounted on and/or adjacent to any installed equipment which, if installed, may impair the proper operation of that equipment, shall be removed by the electrical contractor/subcontractor as required in order that installed equipment shall function properly. ENGINEER shall be notified immediately if any such condition exists.

1.07 REMOVAL OF SALVAGE MATERIAL AND DEBRIS

It shall be the responsibility of the CONTRACTOR to have all trash, salvage material, etc. related to the electrical work completely removed from the project site at all times during construction.

1.08 TRENCHING AND BACKFILLING

- A. All trenching shall be done by mechanical means and all sides straight and vertical. Width of trenches shall not exceed eight inches on either side of placed equipment.
- B. All backfill material and compaction shall meet requirements of Section 02200.
- C. Where required by safety or recommended standards and where any excavated trench or hole is more than five feet deep, install shoring on all sides to protect against sides caving in. Shoring method and material shall be the CONTRACTOR'S responsibility.

1.09 CUTTING, PATCHING, FINISHING AND PAINTING

- A. The CONTRACTOR shall be responsible for all cutting required to install his work. All existing walls shall be carefully trenched, cut, etc. to depths required to completely recess conduit and boxes. Where masonry walls are encountered, blocks and/or brick shall be carefully saw cut to exact box dimensions and conduit shall be routed in cavities, air spaces, etc.
- B. It shall be the responsibility of the CONTRACTOR to have all patching, finishing, painting, etc. done by qualified personnel related to his work.
- C. It shall be the responsibility of the CONTRACTOR to have all exposed conduit, piping and wireways painted where exposed in any space or location.

1.10 CORROSION PROTECTION

It is the intent of these specifications to have all joints, connections, etc. exposed to climatic conditions to be completely watertight using the following:

- A. Nylon gland rings on all Liquid-tite conduit connectors.
- B. Nylon gland rings on all locknuts installed in boxes subject to moisture.
- C. Insulated throat connectors on all compression connectors.
- D. Corrosion inhibitors shall be placed in all environmental, control panels, exposed to damp or wet locations. Inhibitors shall be an approved equal to "Hoffman" A-HCI-1, A-HCI-5 and A-CI-40 and shall be sized in accordance with volume content of the device to be protected.
- E. Where equipment is exposed to severe conditions such as salts, acids, alkalies, sewer gases, etc., all equipment shall be sprayed inside and out with two coats of General Electrical "Glyptal No. 1201-A" or equal, as approved by the Engineer.

1.11 PROJECT SITE INSPECTION

It shall be the responsibility of the CONTRACTOR to visit the proposed sites and make his own observation of the work to be done under the plans and specifications and same shall be contained in

his bid proposal. Failure to do so will not relieve him of any responsibility and will not be justification for requesting additional money from the OWNER.

1.12 COORDINATION OF EXISTING UTILITIES

It shall be the responsibility of the CONTRACTOR to coordinate all existing utilities location both overhead and underground and verify their locations with the various utilities prior to commencing any work. CONTRACTOR shall call Kansas One Call System, 811, and obtain a utility location request number and refer to this number each time a utility company is notified of diggings or trenching near their utilities. Failure to do this shall not relieve him of any responsibility and will not be justification for requesting additional money from the OWNER due to damage of any of these utility lines.

1.13 CONSTRUCTION TOOLS, UTILITIES AND BUILDINGS

The CONTRACTOR shall furnish all tools, utilities, job office and storage buildings required for his use and to protect all electrical equipment as directed by the ENGINEER.

1.14 PAYMENT ITEMS

Progress payments shall be made to the CONTRACTOR based on the percentage of work performed on various payment items. The electrical payment items shall be included with the preliminary schedule of values and payment requests submitted by the CONTRACTOR.

1.15 MANUFACTURER'S RECOMMENDATIONS

Where installation procedures are specified to be in accordance with the recommendations of the manufacturer of the material or equipment being installed, printed copies of these recommendations shall be furnished to the ENGINEER by the CONTRACTOR prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.16 SUBMITTALS

Specific items requiring submittals shall be as specified herein. Shop drawings shall be submitted and approved before procurement, fabrication or delivery of such items to the project site. Partial submittals are not acceptable; such submittals will be returned without review.

A. Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature, equipment drawings, diagrams, performance and characteristic curves and catalog cuts. Each submittal shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, specification reference, applicable federal, military and industry specification references and all other information necessary to establish contract compliance.

B. Shop drawings shall show types, sizes, accessories, elevations, plans, sectional view, installation details, elementary diagrams and wiring diagrams. Wiring diagrams shall identify circuit terminals and shall indicate the internal wiring for each item of equipment and the

-
- C. interconnection between the items. Drawings shall also indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If any equipment is disapproved, the drawings shall be revised to show acceptable equipment and be resubmitted.
 - D. Standards Compliance: When materials or equipment must conform to the standards of organizations such as the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturer's Association (NEMA) and Underwriters' Laboratories (UL), proof of such conformance shall be submitted to the ENGINEER for approval. If any organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual sections. In lieu of the label or listing, the CONTRACTOR shall submit a certificate from an independent testing organization, which is competent to perform acceptable tests and is approved by the ENGINEER. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval. The certificate shall identify the manufacturer, the product and the referenced standard and shall simply state that the manufacturer certifies that the product conforms to all requirements of the project specification and of the referenced standards listed.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

All materials, equipment and devices shall, as a minimum standard, meet the requirements of UL where UL standards are established for those items and the requirements of NFPA 70. All items shall be new unless specified or indicated otherwise.

2.02 NAMEPLATES

Fed. Spec. L-P-387. Provide laminated plastic nameplates for each panel, motor control center, transformer, relay, contactor, starter, safety switch and device. Each nameplate inscription shall identify the equipment and serving panel, and when applicable, the location. Nameplates shall be melamine plastic, 0.125-inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the black core. Minimum size of nameplates shall be as follows:

- A. Style No. 1: 1.0 inch by 2.5 inches for panelboard and terminal cabinet enclosures.
- B. Style No. 2: 0.5 inch by 1.5 inches for safety switches, enclosed individually mounted circuit breakers, small junction/terminal boxes, etc.

2.03 WARNING SIGNS

ANSI Z35.1. Provide warning signs for the power panel enclosures. Provide signs with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3-inch high letters.

PART 3 - EXECUTION

3.01 NAMEPLATE MOUNTING

Provide number, location and letter designation of nameplates. Fasten nameplates to the device or enclosure with a minimum of two oval head stainless steel screws.

3.02 PAINTING OF EQUIPMENT

- A. Factory Applied: Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test.
- B. Field Applied: Paint electrical equipment as required to match finish or to meet safety criteria. Painting shall be a minimum of three coats consisting of primer and two finish coats. Touch-up paint of all equipment shall be required where equipment has become damaged as a result of handling, rusting, etc. Paint shall be applied in even three coats, consisting of prime coat and two finish coats. See plans for special PVC applications.

END OF SECTION

SECTION 16020

CODES AND STANDARDS

PART 1 - GENERAL

1.01 DESCRIPTION

The following codes and standards shall be complied with as though fully written herein in these specifications and shall be applicable to CONTRACTOR, supplier and manufacturer. Dates and amendments shall be the latest edition thereof in force at time of project bid date. Bidders shall be responsible for obtaining their own copies of these codes and standards and pay all cost thereof. Bidders may request addresses of codes and standards issuing agency from ENGINEER in writing in sufficient time to obtain required copies from issuing standards institute.

- A. National Fire Protection Association (NFPA)
 - NFPA 70 National Electrical Code (N.E.C.)
 - NFPA 78 Lightning Protection Code
 - NFPA 77 Recommended Practice on Static Electricity
- B. American National Standards Institute (ANSI)
 - ANSI B16.11 Forged Steel Fittings, Socket Welding and Threaded
 - ANSI C57.12.01 General Requirements for Dry-Type Distribution and Power Transformers
 - ANSI C57.12.91 Test Code for Dry-Type Distribution and Power Transformers
 - ANSI Z35.1 Accident Prevention Signs
 - C80.1 Specification for Rigid Steel Conduit, Zinc-Coated
- C. Occupational Safety and Health Act (OSHA) Requirements
- D. Underwriters Laboratories (UL)
 - UL 6 Rigid Metallic Conduit
 - UL 50 Cabinets and Boxes
 - UL 360 Liquid-Tite Flexible Steel Conduit
 - UL 467 Grounding and Bonding Equipment
 - UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - UL 468C Splicing Wire Connectors
 - UL 489 Molded Case Circuit Breakers
 - UL 508 Enclosures
 - UL 510 Insulating Tape
 - UL 514A Outlet Boxes and Fittings
 - UL 651 Schedule 40 and 80 Rigid PVC Conduit
 - UL 854 Service-Entrance Cables
 - UL 869 Service Equipment
 - UL 943 Ground-Fault Circuit Interrupters
 - UL 1059 Terminal Blocks

-
- | | |
|---------|--|
| UL 1449 | Transient Voltage Surge Suppressors |
| UL 1561 | Dry-Type General Purpose and Power Transformers |
| UL 1581 | Reference Standard for Electrical Wires, Cables and Flexible Cords |
| UL 2200 | Stationary Engine Generator Assemblies |
- E. National Electrical Manufacturer's Association (NEMA)
- | | |
|------|--|
| WC3 | Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy |
| TC3 | PVC Fittings for Use with Rigid PVC Conduit and Tubing |
| RN1 | PVC Externally Coated Rigid Galvanized Steel Conduit and Electrical Metallic Tubing |
| ICS1 | General Standards for Industrial Control and Systems |
| ICS2 | Standards for Industrial Control Devices, Controllers and Assemblies |
| ICS6 | Terminal Blocks for Industrial Control Equipment and Systems |
| TC2 | Electrical Plastic Tubing (EPT) and Conduit EPC-40 and EPC-80 |
| TR1 | Transformers, Regulators and Reactors |
| WD1 | General Purpose Wiring Devices |
| LA1 | Surge Arrestors |
- F. Institute of Electrical and Electronic Engineers (IEEE): Standard Dictionary of Electrical and Electronics Terms
- G. American Society for Testing and Materials (ASTM)
- | | |
|------|---|
| A53 | Pipe, Steel, Black and Hot-Dipped Zinc-Coated |
| A123 | Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| A153 | Zinc Coating (Hot-Dip) on Iron and Steel Hardware |
| B8 | Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft |
| A525 | General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process |
| A780 | Repair of Damaged Hot-Dip Galvanized Coatings |

PART 2 - PRODUCT (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 16030

ELECTRICAL SYSTEMS SCHEDULE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. CONTRACTOR to furnish all materials and labor and perform all operations, including, but not limited to, coordination with general construction shop and field drawings, manufacturer's recommendations and installation instructions, to produce a complete and operative system. It is specifically noted that the plans are diagrammatic and the specifications are descriptive and do not show every piece of equipment, conduit, wiring boxes, etc.; however, where any mention of a system or system operation is indicated in the contract documents, CONTRACTOR shall provide material and labor for that system to be fully operational to the satisfaction of the ENGINEER and OWNER.
- B. The following operative systems shall be applicable to this project.
 - 1. Secondary 120/240-volt service and distribution system, complete with conduit, conductors, termination lugs, trenching and backfill, and testing.
 - 2. Building power system (600-volt and below) complete with final electrical connections to all panels, distribution equipment, transformers, etc.
 - 3. Grounding protection system complete with wiring, connectors, ground rods, exothermic connections, compression connectors and certification from supplier.
 - 4. Miscellaneous systems complete as shown on the drawings and as stated herein.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 16040

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Equipment and materials specified by manufacturer's name and catalog number or an approved equal by the ENGINEER unless otherwise specifically stated herein.
- B. CONTRACTOR shall submit to the ENGINEER in triplicate, typewritten copies of all electrical materials and equipment proposed for use on the project within ten (10) days after award of contract. If this list is not received prior to fifteen (15) days after award of contract, CONTRACTOR is required to furnish specified items by manufacturer and catalog number.
- C. Verbal or written requests by sales agents, manufacturer's agents, CONTRACTOR'S or subcontractors for substitutions of specified equipment by manufacturer and catalog number prior to opening of bids will not be considered or approved. In no case will prior approval be given verbally or in writing of any equipment whether specified by manufacturer and catalog or not prior to opening of bids.
- D. CONTRACTOR shall not place any orders or release shipment of any piece of equipment or materials until all formal submittals have been approved by ENGINEER including any supplemental submittal requirements requested by the ENGINEER.
- E. Samples of any equipment or materials may be required at the ENGINEER's request. This shall apply to specified items and substituted items. Samples shall be made available to the ENGINEER at his designated location. Special equipment such as motor control centers, generators, automatic transfer switch, radio equipment, fire alarm or intrusion alarm systems would be required to be set up and inspections made available at the manufacturer's plant locations. All expenses for travel, per diem, etc. will be paid for by the CONTRACTOR. This expense may include an OWNER'S representative.
- F. The ENGINEER's opinion shall be final and binding on the approved equal status for equality of any substituted item from that listed by manufacturer and/or manufacturer catalog number.
- G. Submittals for approval by ENGINEER shall include shop drawings, manufacturer's brochures and data sheets, samples where required such as paint, waterproofing, marking tape, wiring and cable; test reports, testing procedures, finishes, etc. Refer to Section 01340.
- H. Submittals shall be required, but not limited to, the following:
 - 1. Wire and cable.
 - 2. Conduit and fittings.
 - 3. Boxes, covers and plates.
 - 4. Branch circuit compression connectors.
 - 5. Marking and identification devices.

-
6. Grounding system.
 7. Paint.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 16111
CONDUIT AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Liquid-Tite flexible metal conduit.
- D. Non-metal conduit.
- E. Fittings and conduit bodies.

1.02 RELATED SECTIONS

- A. Section 16130, Boxes.
- B. Section 16170, Grounding and Bonding.
- C. Section 16190, Supporting Devices.
- D. Section 16195, Electrical Identification.

1.03 REFERENCES

- A. ANSI C80.1 — Rigid Steel Conduit, Zinc Coated
- B. ANSI/NEMA PB 1 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies.
- C. ANSI/NFPA 70 - National Electrical Code.
- D. NECA "Standard of Installation".
- E. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
- F. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- G. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.04 DESIGN REQUIREMENTS

Conduit Size: ANSI/NFPA 70 (unless noted otherwise on the drawings and contained herein).

1.05 SUBMITTALS

- A. Submit under provisions of Section 16010, General Requirements and Section 01340, Shop Drawings, Product Data and Samples.
- B. Product Data: Provide for metallic conduit, Liquid-tite flexible metal conduit, non-metallic conduit, conduit bodies and fittings.

1.06 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 16010.
- B. Accurately record actual routing of all underground conduits and mark on record drawings.

1.07 FIELD SAMPLES

- A. Provide under provisions of Section 16040.
- B. Provide field sample of connectors and fittings.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept conduit on site. CONTRACTOR shall, prior to acceptance, inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

1.09 PROJECT CONDITIONS

- A. Verify all field measurements as required or shown on drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required parallel and perpendicular to structures.

PART 2 - PRODUCTS

2.01 CONDUIT REQUIREMENTS

- A. All wiring shall be installed in conduit, including power, low voltage, sensor control, and instrumentation.
- B. Minimum size conduit shall be as follows:
 - 1. 3/4-inch for power and branch circuit wiring, unless noted otherwise on the drawings.
 - 2. 1-inch for low voltage, sensor control and instrumentation, unless noted otherwise on the drawings.
- C. Conduit shall be installed in accordance with the following schedule:
 - 1. Outside secondary service and feeder conduit risers above grade: Galvanized thick wall rigid steel (GRC).
 - 2. Conduit in earth (no encasement): Galvanized thick wall rigid steel (GRC) or Schedule 80 PVC as noted. Metallic conduit shall be coated with three (3) coats of polyvinyl polyethylene or hot asphalt application.
 - 3. In masonry walls: Galvanized thick wall rigid steel (GRC), or EMT.
 - 4. Above suspended ceilings: Galvanized thick wall rigid steel (GRC) or Electrical metallic tubing (EMT).
 - 5. In metal stud walls: Galvanized thick wall rigid steel (GRC) or Electrical metallic tubing (EMT).
 - 6. In exposed locations and outdoors: Galvanized thick wall rigid steel (GRC).
 - 7. Conduit in earth (concrete encased): Galvanized thick wall rigid steel (GRC), or Schedule 40 PVC. When PVC is used, change to galvanized rigid at and including elbow and rise up in (GRC).

2.02 FITTINGS

- A. Where conduits, 1/2-inch through 1-inch conduits, enter junction boxes, pullboxes, panels, cabinets, gutters, etc. use insulated throat connectors, Raco Cat. #1003 and 1004, Locknuts #1133 and 1134, insulated throat bushing and #1222, 1223, and 1224, insulated throat ground bushings for rigid conduit, Raco Cat. #2912, 2913, 2914, for EMT. Raco Cat. #3302, 3303, 3304 for flexible metal conduit. Raco Cat. 3512, 3513 and 3514 for Liquid-Tite connectors. Conduits 1-1/4-inch and above entering junction boxes, pullboxes, panels, cabinets, gutters, etc. shall have insulated throat grounding bushings equal to Raco Cat. #1225, 1226, 1228, 1230, 1232, 1234 and 1236.
- B. Only threaded joint connectors and malleable iron no thread compression box connectors shall be used on rigid conduit. No fittings requiring set screws or indentor type applications, including BM connectors, will be allowed.

2.03 CONDUIT STRAPS AND HANGERS

Two (2) hole push-on stamped straps Raco Cat. #2232, 2233, 2234, 2235, 2236 and 2238 for rigid conduit. These anchors shall be used on surface areas such as concrete, masonry, wide flange beams, columns and wood. All screws shall be stainless steel.

2.04 EXPANSION AND SEAL OFF FITTINGS

Install seal-off fittings where required by code or shown on the drawings for the job. Fittings shall be Crouse-Hinds Type EYS for vertical runs, Type EZS for horizontal and vertical runs, or Type EYS elbow seals, or equal as approved by the Engineer, in Killark or Appleton. All seals shall be properly installed using a non-hardening sealing compound and shall be sealed as soon as cable is installed.

2.05 RIGID METAL CONDUIT

- A. Manufacturers:
 - 1. Allied
 - 2. Wheatland
 - 3. Republic
 - 4. Or equal, as approved by the Engineer.
- B. Rigid Galvanized Steel Conduit (GRC): ANSI C801. UL 6.

2.06 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Alflec
 - 2. Anamet
 - 3. AFC
 - 4. Or equal, as approved by the Engineer.
- B. Description: Interlocked aluminum construction with PVC jacket.
- C. Fittings: ANSI/NEMA FB1.

2.07 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tubing
 - 2. LTV Steel
 - 3. Wheatland
 - 4. Triangle
 - 5. Or equal, as approved by the Engineer.
- B. Description: ANSI C80.3, UL 797 zinc-coated. Maximum size 2 inches.

2.08 NON-METALLIC CONDUIT

- A. Manufacturers:
 - 1. Carlon

-
- 2. Or equal, as approved by the Engineer.
 - B. Description: NEMA TC2; Schedule 80 PVC.
 - C. Fittings and Conduit Bodies: NEMA TC3.

2.09 ALUMINUM CONDUIT

- A. Manufacturers
 - 1. Allied Tubing
 - 2. Or equal, as approved by the Engineer.
- B. Description: ANSI C 80.5, U.L. 6.

2.10 CONDUIT IDENTIFICATION PLATES

- A. Conduit identification plates shall be brass with stainless steel and permanently secured to the conduit without screws.
- B. Identification plates shall be as manufactured by the Panduit Corp or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation".
- B. Install non-metallic conduit in accordance with manufacturer's instructions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel straps with stainless steel screws.
- E. Fasten conduit supports to structures and surfaces under provisions of this section.
- F. Do not support conduit with wire or perforated pipe straps in any type structure. Remove wire used for temporary supports.
- G. Route all conduit, whether exposed or concealed, parallel and perpendicular to structures.
- H. Route conduit in and under slab from point-to-point.
- I. Maintain 12-inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104°F. (40°C.).
- J. Bring conduit to shoulder of fittings, fasten securely.

-
- K. Join non-metallic conduit using cement as recommended by manufacturer. Wipe non-metallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
 - L. Use conduit hubs for sealing locknuts to fasten conduit to cast boxes. All conduit entering top or sides of all junction boxes, pullboxes, wiring gutters, etc., exposed to weather shall have myers hub connectors.
 - M. Install no more than equivalent of four 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2-inch (50 mm) size. Radio telemetry system conduit bends shall not exceed two (2) 90-degree turns. All bends shall be long radius. All field bends on conduit shall be made in accordance with tables in Article 346, NFPA 70.
 - N. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
 - O. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
 - P. Provide suitable nylon pull string or No. 14 AWG steel wire in each conduit except sleeves and nipples.
 - Q. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
 - R. Ground and bond conduit under provision of Section 16170.
 - S. Identify conduit under provisions of Section 16195.
 - T. All conduit male threads shall be coated with "General Electric" RTV silicone sealer where conduit is installed outdoors, in contact with concrete or earth.
 - U. All feeders shall be run in galvanized or sheradized thick wall rigid steel (GRC), or EMT.
 - V. All conduits shall be sized as noted on the drawings and contained herein. Where size not shown, consult ENGINEER.
 - W. All upturned conduits shall be capped during construction rough-in to prevent moisture or debris from entering. Pull through each and every conduit a dry swab of sufficient size to remove any and all moisture. Seal all conduit terminations with GE Silicone or duct puddy prior to final acceptance of the project.
 - X. Maximum length of flexible liquid-tite conduit shall not exceed 5 feet.
 - Y. Assure ground continuity on all branch circuitry conduits with myers hubs, one inside and one outside of all boxes, cabinets and gutters for rigid conduit.
 - Z. Conduit Curb:

-
1. In concrete slabs or floors, provide a 2-inch high curb extending 2-inches from the outer surface of the conduit penetrating the floor, to prevent corrosion.
 2. Terminate conduit stub-ups in couplings, slightly above the finished concrete curb.
 3. Paint the stub-up with Scotch-Clad Protective Coating #1706 or equal, a minimum of 6-inches above and below the finished surface of the concrete.
- AA. Each conduit shall have brass tab with conduit number stamped and attached by stainless steel chain.

3.02 CONDUIT SUPPORTS

Support conduits as follows:

- A. Galvanized rigid thick wall conduit (GRC), IMC and EMT, within three feet of all outlet boxes, junction boxes, cabinets, gutters or fittings. Horizontally anchored at 10'-0" maximum intervals. Other spacings are noted on the plans.
- B. Liquid-tite flexible conduit (Sealtite), within 12 inches of all outlet boxes, junction boxes, cabinets, gutters or fittings and bends or turns. Horizontally anchored at 2-foot intervals. Minimum size permitted is 3/4-inch.

END OF SECTION

SECTION 16120
WIRE AND CABLE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Building wire.
- B. Cable including instrumentation, control, etc.
- C. Wiring connections and terminations.

1.02 REFERENCES

- A. NEMA WC 3 - Rubber-insulated wire and cable for the transmission and distribution of electrical energy.
- B. NEMA WC 5 - Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.

1.03 SUBMITTALS

- A. Submit manufacturer's product data under the provisions of Section 16010, General Requirements.
- B. Submit manufacturer's instructions.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. Thermoplastic-Insulated Building Wire: NEMA WC 5.
- B. Rubber-Insulated Wire: NEMA WC 3.
- C. Feeders and Branch Circuits: Copper, stranded conductor, 600-volt insulation, THWN.
- D. Service Entrance Cable: Copper, stranded conductor, 600-volt insulation, THHN - THWN.
- E. Control Circuits: Copper, stranded conductor, 600-volt insulation, THHN - THWN.
- F. Electronic Sensor Cable: Per manufacturer's recommendations.
- G. Instrumentation Cable: Per manufacturer's recommendations.

PART 3 - EXECUTION

3.01 GENERAL WIRING METHODS

- A. Use no wire smaller than #12 AWG for power circuits and no smaller than #14 AWG for control wiring.
- B. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
- C. Splice only in junction or outlet boxes.
- D. Neatly train and lace wiring inside boxes, equipment and panelboards.

3.02 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricate for pulling #4 AWG and larger wires.
- B. Completely and thoroughly swab raceway system before installing conductors.

3.03 CABLE INSTALLATION

Provide protection for exposed cables where subject to damage.

3.04 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- D. Terminate spare conductors with electrical tape and wire nut.
- E. Splices in all junction boxes shall be made by the compression method. Crimp connectors shall be "Buchanan" Cat. #2006S, #2008S or #2011S with #2007, #2014 or #3007B caps or equal, as approved by the Engineer..

3.05 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 16010.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque test conductor connections and terminations to manufacturer's recommended values.

-
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

3.06 WIRE AND CABLE INSTALLATION SCHEDULE

- A. Exterior Locations: Conductors in raceways.
- B. Underground Locations: Conductors in raceways.
- C. Color Coding (Power System): The following conductor color coding shall be used:

480/277-Volt System

Phase A - Brown
Phase B - Orange
Phase C - Yellow
Neutral - Gray
Equipment Ground - Green

208Y/120-Volt System

Phase A - Black
Phase A - Switch Leg - Gray
Phase B - Red
Phase B - Switch Leg - Pink
Phase C - Blue
Phase C - Switch Leg - Purple
Travelers - Yellow
Neutral - White
Equipment Ground - Green

END OF SECTION

SECTION 16130

BOXES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

1.02 RELATED SECTIONS

- A. Section 16111, Conduit and Fittings.
- B. Section 16140, Wiring Devices.
- C. Section 16160, Cabinets and Enclosures.
- D. Section 16180, Equipment Wiring Systems.

1.03 REFERENCES

- A. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- B. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- D. ANSI/NFPA 70 - National Electrical Code.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.04 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Sections 16010, General Requirements and 01340, Shop Drawings, Product Data and Samples.
- B. Submit manufacturer's data.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01720.
- B. Accurately record actual locations and mounting heights of outlet, pull, and junction boxes.

1.06 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.07 PROJECT CONDITIONS

- A. Verify field measurements as shown on Drawings.
- B. Verify locations of boxes and outlets in plant laboratory, offices and work areas prior to rough-in.
- C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. Include installation within 20 feet of location shown.

PART 2 - PRODUCTS

2.01 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2-inch or 3/4-inch male fixture studs where required.
 - 2. Only 4-inch square boxes with raised gang covers will be allowed.
- B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs as required.

2.02 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Surface-Mounted Cast Metal Box: NEMA 250, Type 6; flat-flanged, surface-mounted junction box.
 - 1. Material: Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
 - 3. PVC coated over water plant facility.
- C. In-Ground or Concrete Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting.
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: ELECTRIC, COMM.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- B. Install electrical boxes to maintain headroom and to present neat mechanical appearance.
- C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- D. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- E. Install boxes to preserve fire resistance rating of partitions and other elements.
- F. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.
- G. Use flush mounting outlet boxes in finished areas with raised gang covers.
- H. Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inch (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic rated walls.
- I. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- J. Use stamped steel bridges to fasten flush mounting outlet box between studs. Span between studs.
- K. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- L. Use adjustable steel channel fasteners for hung ceiling outlet box.
- M. Do not fasten boxes to ceiling support wires.
- N. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- O. Use gang box where more than one device is mounted together. Do not use sectional box.
- P. Use gang box with plaster ring for single device outlets.
- Q. Use cast outlet box in exterior locations exposed to the weather and wet locations.

-
- R. Large Pull Boxes: Boxes larger than 100 cubic inches (1600 cubic centimeters) in volume or 12 inches (300 mm) in any dimension.
 - 1. Interior Dry Locations: Use hinged enclosure under provisions of Section 16160.
 - 2. Other Locations: Use surface-mounted cast metal box.
 - S. All conduit connections to enclosure shall use myers hub.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate installation of outlet box for mechanical equipment furnished under Division 15.
- B. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. Use raised gang square covers.
- C. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
- D. Position outlet boxes to locate luminaires as shown on drawings.

3.03 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material. Maximum tolerance is 1/8-inch recess in finished wall.
- B. Install knockout closure in unused box opening.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

Furnish and install wiring devices as shown or noted on plans, including all required mounting hardware, etc.

1.02 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Sections 16010 and 01340, Submittals.
- B. Submit manufacturer's data.

PART 2 - PRODUCTS

2.01 SAFETY SWITCHES

- A. Type: Horsepower rated, heavy-duty, single throw, three pole with visible blade and safety handle. Fused and/or unfused as specified elsewhere and/or designated on the Drawings and/or as required by NEC. Sized as required by NEC and/or as shown on the Drawings.
- B. Each switch shall have indented plastic phenolic sign (minimum 1/8-inch lettering) identifying load served with voltage and horsepower attached to switch with stainless steel screws.
- C. Enclosure: Painted Steel NEMA 1 for dry, indoor locations and Stainless Steel NEMA 4X for outdoor and wet locations.
- D. Manufacturers:
 - 1. Square D Co.
 - 2. General Electric Co.
 - 3. Westinghouse.
 - 4. Or equal.

2.02 RECEPTACLE

- A. Indoor Locations:
 - 1. Duplex grounding receptacle, two pole, three wire, 125 volt AC, 20 ampere, stainless steel cover plates. Products and Manufacturers:
 - a. Cat. #5362-CR, by Arrow-Hart Inc.

-
- b. Cat. #53CM62, by Harvey Hubbell Inc.
 - c. Or equal.
 - 2. Single grounding receptacle, corrosion resistant, two pole, three wire, 125 volt AC, 20 ampere, stainless steel cover plates. Products and Manufacturers:
 - a. Cat. #5361-CR, by Arrow-Hart Inc.
 - b. Cat. #53CM61, by Harvey Hubbell In
 - c. Or equal.
 - B. Ground Fault Receptacle Where Designated on the Drawings:
 - 1. Type: UL listed, 20 ampere, 125 volt AC, sensitivity of 5 mA, three wires, weather-proof cover plates.
 - 2. Manufacturer:
 - a. Hubbell, No. 6F-5362-GY with a 5221 cover plate.
 - b. Or equal.
 - C. Weatherproof Receptacle Where Designated on the Drawings: Type UL listed duplex grounding receptacle, corrosion resistant, two pole, three wire, 20 ampere, 125 volt AC, weatherproof cover plates.

2.03 SWITCHES

- A. Indoor Non-Hazardous Locations:
 - 1. Single pole AC toggle switch, quiet type, 120/277 volt AC, 20 ampere, Brown, specification grade with stainless steel cover, screws and grounding terminal. Products and Manufacturers:
 - a. Cat. #20AC1 by Pass & Seymour, Inc.
 - b. Cat. #CS 120 by Hubbell.
 - c. Or equal.
 - 2. Toggle switches of the three-way type shall be quiet type, 120/277 volt AC, 20 ampere, specification grade with stainless steel cover, screws and grounding terminal. Products and Manufacturers:
 - a. Cat. #20AC3 by Pass & Seymour, Inc.
 - b. Cat. #CS 320 by Hubbell.
 - c. Or equal.
 - 3. Toggle switches of the four-way type shall be of the same grade and manufacture as the single pole and three-way type.
 - 4. Toggle switches of the two-pole, single throw type shall be of the same grade and manufacturer as above.
 - 5. Dimming Switch:
 - a. Coordinated with fluorescent fixture ballasts specified.
 - b. Suitable for controlling light output from two of a four-lamp fluorescent fixture.
 - c. Include integral snap switch on dimming dialer.
 - d. Manufacturer:
 - (1) Thyrocon Controls.
 - (2) Hunt.
 - (3) Or equal.

-
- B. Horsepower-Rated Switches:
 - 1. Type: Toggle operated, horsepower rated with thermal overload protection.
 - 2. Enclosure: NEMA 1 for dry, indoor locations and NEMA 4 for outdoor and damp or wet indoor locations.
 - 3. Products and Manufacturers: Provide one of the following:
 - a. Type 609T by Allen-Bradley.
 - b. Class 2510 by Square D Co.
 - c. Or equal.

2.04 FUSES

- A. Type: Dual-element, current-limiting, UL Class RK5, 600 volts, unless otherwise noted or specified.
- B. Interrupting Capacities (UL Listed): 200,000 RMS amperes.
- C. Coordination:
 - 1. Coordinated for installation in existing and new equipment.
 - 2. Properly coordinated for size, type and rating as required for equipment and circuits to be protected.
- D. Repair Parts: One replacement fuse for each and every fuse installed under this Contract.
- E. Manufacturers: Provide products from one of the following:
 - 1. Bussman Division, McGraw Edison Company.
 - 2. Gould Inc., Circuit Protection Division.
 - 3. Or equal.

PART 3 - EXECUTION

3.01 MOUNTING

- A. Safety switches shall be mounted on structural frame with minimum of four points of attachment using stainless or galvanized steel hardware.
- B. Install one spare set of fuses inside fused switch enclosure attached to side.
- C. In non-hazardous locations, install wiring devices in outlet or device boxes.
- D. Mount wall switches four feet, zero inches above finished floor unless otherwise noted.

END OF SECTION

SECTION 16160
CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Mounting panel.
- D. Terminal blocks and accessories.

1.02 REFERENCES

- A. NEMA 250 - Enclosures for electrical equipment (1,000 volts maximum).
- B. ANSI/NEMA ICS 1 - Industrial control and systems.
- C. ANSI/NEMA ICS 4 - Terminal blocks for industrial control equipment and systems.
- D. ANSI/NEMA ICS 6 - Enclosures for industrial control equipment and systems.
- E. UL 50 - Enclosures.

1.03 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Sections 16010 and 01340, Shop Drawings, Product Data and Samples.
- B. Shop Drawings for Equipment and Enclosure Panels: Include wiring schematic diagram, wiring diagram, outline drawings and construction diagram as described in ANSI/NEMA ICS 1.

PART 2 - PRODUCTS

2.01 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250; Type 3, steel.
- B. Finish: Dark gray, rust inhibitor.
- C. Covers: Continuous hinge, held closed by hasp and staple for padlock.

2.02 CABINETS

- A. Construction:
 - 1. 14-gauge G-90 grade galvanized steel.
 - 2. Drip shield top and seam-free sides, front and back.
 - 3. 16-gauge galvanized steel continuous hinge with stainless steel pin.
 - 4. Cover fasteners with captive plated steel screws.
 - 5. Hasp and staple for padlocking.
 - 6. Knockouts in bottom.
 - 7. Collar studs with back mounting panel.
 - 8. Dark gray epoxy finish. Red finish on fire alarm terminal cabinet.
 - 9. Corrosion inhibitors.
 - 10. Electric heater with thermostat where located outdoors.
 - 11. Size: Verify size required with equipment to be housed or as noted on drawings.
- B. Manufacturer and Catalog No.: Hoffman Cat. No. scheduled with back panel or equal, as approved by the Engineer. (minimum size).

2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.
- B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install cabinets and enclosures plumb; anchor securely to structural supports at each corner with galvanized bolts, nuts and Belleville washers.
- B. Install trim plumb.

END OF SECTION

SECTION 16170
GROUNDING AND BONDING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Power system grounding.
- B. Communication and instrumentation system grounding.
- C. Electrical equipment and raceway grounding and bonding.
- D. Building ground grids.

1.02 SYSTEM DESCRIPTION

- A. Ground the electrical service system neutral at service entrance equipment to grounding electrode.
- B. Provide communications system grounding conductor at point of service entrance and connect to grounding electrode.
- C. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground and connectors.
- D. Ground building slab and metal structure as detailed on the drawings.

1.03 SUBMITTALS

- A. Submit maintenance and grid layout data and shop drawings under provisions of Sections 16010 and 01340.
- B. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Ground Rods: Copper-encased steel, 5/8-inch diameter, minimum length 10 feet.
- B. Ground Conductor Building Grid: 4/0 bare copper.

-
- C. Ground Electrode Conductor: Size as noted on drawings with THWN insulation.
 - D. Exothermic welds shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide a separate, insulated equipment grounding conductor in branch circuits. Terminate each end on a grounding lug, bus or bushing.
- B. Connect grounding electrode conductors to ground electrode by exothermic weld using cable to rod connection.
- C. Grounding Electrode: Use driven ground rod as shown on plans.
- D. Use minimum #6 AWG copper conductor for communications service grounding conductor. Leave six feet (3 m) slack conductor at terminal cabinet or backboard.
- E. Provide grounding and bonding at utility company's metering equipment.
- F. Bond all metal parts of building, equipment support structures, tanks, etc. to building ground grid.
- G. Ground grid around each building and concrete structures shall have rods spaced maximum of 20'-0" center to center with complete loop of 4/0 copper bare conductor with exothermic weld to each rod. Each column point around perimeter of building shall be bonded to grid, loop with 4/0 bare copper routed in slab in 12-inch Schedule 40 PVC sleeve. Bond ground bus to perimeter grid using 4/0 bare copper in 12-inch Schedule 40 PVC conduit.
- H. Refer to drawings for schedule of exothermic connections.
- I. Install 4/0 ground in each duct bank.

3.02 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 5 ohms. Where resistance exceeds 5 ohms, additional ground rods shall be driven. Top of all rods shall be a minimum of 2'-0" below finish grade elevation.

-
- C. Do not cover and ground grid or connections until inspected and approved by ENGINEER.

END OF SECTION

SECTION 16180
EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Make all final electrical connections to all equipment shown on drawings or required for a complete and operable system.
- B. All final electrical connections shall be made in strict compliance with NPFA-70 National Electrical Code Latest Edition.

1.02 RELATED SECTIONS

- A. Section 16010, General Requirements.
- B. Section 16020, Codes and Standards.
- C. Section 16111, Conduit and Fittings.
- D. Section 16120, Wire and Cable.
- E. Section 16130, Boxes.
- F. Section 16170, Grounding and Bonding Systems.

1.03 PROJECT RECORD DOCUMENTS

Submit documents in accordance with provisions of Section 01720.

PART 2 - PRODUCTS

Products are listed under related sections of the specifications.

PART 3 - EXECUTION

3.01 INSTRUCTIONS

- A. Shall be installed in conduit where and as shown on the drawings and in accordance with drawings and specifications.

END OF SECTION

SECTION 16190
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Conduit and equipment supports.
- B. Fastening hardware.
- C. Related Work
 - 1. Refer to Section 03300.

1.02 COORDINATION

Coordinate size, shape and location of concrete pads with details on drawings and manufacturer's recommendations.

1.03 QUALITY ASSURANCE

Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Support Channel
 - 1. Galvanized in non-corrosive areas
 - 2. Aluminum in corrosive areas.
- B. Hardware: Corrosion-resistant.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Fasten hanger rods, conduit clamps and outlet and junction boxes to structure using stainless steel screws and galvanized bolts, nuts and Bellville washers. Do not use spring steel clips and clamps.
- B. Do not fasten supports to conduit.

-
- C. Fabricate supports from steel angle and steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with Bellville washers under all nuts.
 - D. Furnish and install additional steel framing as required to span between ceiling girts for support of lighting fixtures, electric heaters, etc.

END OF SECTION

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Nameplates.
- B. Wire and cable markers.

1.02 RELATED WORK

Section 16010, General Requirements.

1.03 SUBMITTALS

- A. Submit shop drawings under provisions of Sections 16010 and 01340.
- B. Include schedule for nameplates.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts and panels using stainless steel screws.

3.02 WIRE IDENTIFICATION

Provide wire markers on each conductor in enclosures and at load connection. Identify with branch circuit number for power circuits and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

3.03 NAMEPLATE ENGRAVING SCHEDULE

Provide nameplates to identify all electrical distribution and control equipment and loads served. Letter Height: 1/8 inch (3 mm) for individual switches and loads served and 1/4 inch (6 mm) for control equipment panel identification unless noted otherwise.

END OF SECTION

SECTION 16280

SURGE PROTECTIVE DEVICES (SPDs)

PART 1 – GENERAL

1.01 SCOPE

The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to 2.02 of this Section for surge requirements.

1.02 REFERENCES

SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
 - 2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.
- B. The following information shall be submitted to the engineer:
 - 1. Descriptive bulletins,
 - 2. Product sheets.

1.04 SUBMITTALS – FOR CONSTRUCTION

The following information shall be submitted for record purposes: Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process.

1.05 QUALIFICATIONS

-
- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
 - B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
 - C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
 - D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.07 OPERATION AND MAINTENANCE MANUALS

- A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Eaton / Cutler-Hammer products
- B. Or equal, as approved by the Engineer.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

- A. Electrical Requirements
 - 1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
 - 2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

-
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
- a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
 - ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
 - iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
 - c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
 - d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
 - i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
6. Overcurrent Protection
-

-
- a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
 - 7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
 - 8. Safety Requirements
 - a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
 - b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
 - c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.03 SYSTEM APPLICATION

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

- C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

- A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 3. The panelboard shall be capable of re-energizing upon removal of the SPD.
 4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
 5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
 6. The SPD shall be of the same manufacturer as the panelboard.
 7. The complete panelboard including the SPD shall be UL67 listed.
- B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly)
1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.
- C. Switchgear, Switchboard, MCC and Busway Requirements
1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

-
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway.
 3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer.
 4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
 5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
 6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
 7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.05 ENCLOSURES

- A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
 1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
 2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only).

PART 3 – EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 FACTORY TESTING

Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.03 INSTALLATION

The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.04 WARRANTY

The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

SECTION 16461

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION

Dry-type transformers for free-standing floor mounted or wall mounted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 16170 - Grounding and Bonding Systems.

1.03 SUBMITTALS

Submit under provisions of Sections 16010 and 01340.

PART 2 - PRODUCTS

2.01 TRANSFORMERS

- A. Requirements for 208Y/120 volts shall be supplied by dry-type transformers furnished and installed where shown on drawings.
- B. Transformer shall be three-phase, connected 480-volt, three-phase Delta on primary side and 208Y/120-volt, three-phase, four-wire, 60 Hz on secondary side, 2-22% taps above and below nominal voltage.
- C. Transformers shall have 115°C. temperature rise above 40°C. ambient. All insulating materials to be in accordance with NEMA ST20 standards for 220°C., UL component recognized insulation system.
- D. Transformer coils shall be of the continuous wire wound construction and shall be impregnated with non-hygroscopic, thermosetting varnish. Each layer shall have end fillers, or tie-downs, to provide maximum mechanical strength. Materials must have a minimum of one year of proven field usage. Accelerated laboratory tests not acceptable in lieu of actual field experience. Insulation system used shall be component recognized by Underwriter's Laboratories. The coils shall also have a final wrap of electrical insulating material to prevent mechanical injury to the wire as well as increasing the electrical breakdown strength. Coils with exposed wire will not be accepted.
- E. Core shall be constructed of high grade, non-aging silicone steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with structural steel angles. The completed core and coil shall then be bolted to the base of the

enclosure but isolated from the base of the enclosure by means of rubber, vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure. On transformers 500 KVA and smaller, the vibration isolating system shall be designed to provide a permanent fastening of the core and coil to the enclosure. Sound isolating systems requiring the completed removal of all fastening devices will not be acceptable.

- F. The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed and finished with a gray, baked enamel.
- G. The core of the transformer shall be visibly grounded to the enclosure by means of flexible grounding conductor sized in accordance with applicable NEMA and NEC standards.
- H. Sound levels shall be guaranteed by the manufacturer not to exceed to the following:
 - 1. 25 to 50 KVA - 45 DB
 - 2. 51 to 150 KVA - 50 DB
- I. The transformer shall be listed by Underwriters' Laboratory for the specified temperature rise.
- J. Product and Manufacturer: Provide equipment manufactured by one of the following:
 - 1. Square D Company.
 - 2. General Electric Company.
 - 3. Westinghouse Electric Company.
 - 4. Or equal.

PART 3 - EXECUTION

3.01 FREE-STANDING TRANSFORMERS

- A. Mount on floor on minimum of 2-inch vibration neoprene pad.
- B. Electrical connections on each side shall be flexible metal conduit and wiring.

3.02 WALL-MOUNTED TRANSFORMERS

- A. Mount on wall with manufacturer's recommended mounting devices.
- B. Electrical connections on each side shall be flexible metal conduit and wiring.

END OF SECTION

SECTION 16470

LIGHTING AND POWER PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

Lighting and power panelboards.

1.02 RELATED SECTIONS

- A. Section 16010, General Requirements.
- B. Section 16170, Grounding and Bonding Systems.
- C. Section 16195, Electrical Identification.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01340.
- B. Submit manufacturer's data indicating bussing, enclosure, circuit numbering, sizes, etc.

PART 2 - PRODUCTS

2.01 PANELBOARDS

- A. Shall be dead-front construction with solderless pressure terminals.
- B. Main and neutral busses shall be of capacity scheduled on drawings. Bussing shall be tin-plated, copper-based on maximum current density in accordance with UL Standard 891.
- C. Complete typewritten directory with transparent plastic cover inside of door. All panels shall be identified as they are designated on the drawings by 3/4-inch plastic phenolic sign with 1/4-inch indented letters on front face of panel attached with minimum of two (2) screws.
- D. Trim and door with lock and catch with two (2) keys. Keys shall be common to all panelboards.
- E. Circuit Breakers:
 - 1. Circuit breakers shall be quickmake and quickbreak on manual or automatic operation, with minimum interrupting capacity of 10,000 amps RMS symmetrical.
 - 2. Breakers shall be trip-free. Each breaker shall have trip indication independent of the ON or OFF positions.

-
3. All breakers shall be UL listed and meet NEMA Standards Publication No. AB1 and Federal Specification No. WOCO375a and any amendments to the above where applicable.
 4. All breakers shall be calibrated for operation in an ambient temperature of 40° C.
 5. All two- and three-pole breakers shall be common trip.
 6. Automatic operation of the circuit breaker shall be obtained by means of thermal and/or magnetic tripping devices located in each pole. Thermal devices shall provide the time-delay tripping on overloads and the magnetic device shall provide instantaneous tripping on short circuits.
 7. All breakers shall be bolt-on type.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panels shall be securely mounted with through bolts, anchors or other approved means.
- B. Mount all panelboards with top breaker handle not more than 6'-6" above finish floor.
- C. Connect the phase wires of three (and/or four) wire home runs to breakers connected to separate phase busses of the panelboard. Panelboard circuits shall be numbers in sequence vertically and all circuits shall appear in the panel exactly as they are shown on the drawings. All branch circuit neutral connections shall be identified by adhesive number tags to identify with their branch circuit phase conductors where neutral connections connect to the panel neutral bus.
- D. Neutrals and equipment ground conductors shall not be connected together in any panel beyond service entrance main.
- E. No two ungrounded conductors shall be connected to the same circuit breaker terminal.
- F. There shall be no splicing of conductors in panelboards.
- G. Panelboards shall be as scheduled on the drawings and as manufactured by Square D Company, Type NQOD.

END OF SECTION

SECTION 16482

MAGNETIC MOTOR STARTERS

PART 1 - GENERAL

1.01 DESCRIPTION

Scope: Furnish all labor, materials, equipment and incidentals required to provide individually mounted magnetic motor starters as shown and specified. Starters mounted in motor control centers are specified in Section 16480.

1.02 QUALITY ASSURANCE

Reference Standards: Comply with applicable provisions and recommendations of the following except where otherwise shown or specified:

- A. NEMA Standard ICS2-110, General Standards for Manual and Magnetic Controllers.
- B. NEMA Standard ICS2-321 AC General Purpose Class A Controller for Squirrel Cage Induction Motors, 600 volts and less.
- C. UL Electrical Construction Materials Directory (NLDX).
- D. National Electrical Code.

1.03 SUBMITTALS

Shop Drawings: Submit for approval copies of manufacturer's technical information for magnetic motor starters proposed for use. Provide layout drawings and wiring diagrams for each different motor starter.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General:
 - 1. Type: Magnetic coil operated, horsepower rated with thermal overload protection.
 - 2. Combination starter with magnetic only motor circuit protector.
 - 3. Enclosures: NEMA 1 for dry, indoor locations and NEMA 4X for outdoor and damp, wet or corrosive indoor locations.
 - 4. Functional Type: Full voltage, single speed, nonreversing unless otherwise noted on Drawings.
 - 5. Start/stop control stations, selector switches, pilot lights and devices as shown on Drawings.

-
6. Control power transformer with primary and secondary fuses and grounded on low voltage (120 V) side for each starter.
 7. Auxiliary contacts for motor space heaters, remote status signals and interlocks as shown on the Drawings.
 8. Overload relays of the temperature compensated type and overload heaters sized to coordinate with actual motors being controlled.
 9. Nameplate identifying the equipment controlled.
- B. Product and Manufacturer: Provide one of the following:
1. Type A 206 by Westinghouse Electric Corporation.
 2. Type CR287 by General Electric Company.
 3. Bulletin 512 by Allen Bradley Company.
 4. Class 8539 by Square D Company.
 5. Or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount equipment so that sufficient access and working space is provided for safe operation and maintenance.
- B. Securely fasten equipment to walls or other mounting surfaces. Where local wall is not available, provide galvanized steel supports to rigidly support equipment reasonably close to motor.
- C. Install in conformance with the National Electrical Code.

END OF SECTION

SECTION 16501

LAMPS

PART 1 - GENERAL

1.01 DESCRIPTION

Lighting fixture lamps.

1.02 RELATED SECTIONS

- A. Section 16010, General Requirements.
- B. Section 16510, Interior and Exterior Lighting System.
- C. Section 16535, Self-Contained Emergency Lighting System.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01340.
- B. Submit manufacturer's data sheets showing manufacturer, wattage, type, lumens and general characteristics of each type lamp.

PART 2 - PRODUCTS

2.01 LAMPS

- A. Lamps shall be of the proper size and type as noted in the fixture schedule for each type fixture.
- B. Incandescent lamps shall be inside frosted, 120 volts, as manufactured by General Electric, Sylvania or equal, as approved by the Engineer.
- C. Fluorescent lamps shall be rapid start, energy savings as manufactured by General Electric, Sylvania or equal, as approved by the Engineer.
- D. High pressure sodium lamps shall be clear, universal burn as manufactured by General Electric, Sylvania or equal, as approved by the Engineer.
- E. Metal halide lamps shall be base up to horizontal burn position. They shall be Metalarc/C lamps as manufactured by Sylvania or equal, as approved by the Engineer.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 16510
INTERIOR AND EXTERIOR LIGHTING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

Interior and exterior building lighting fixtures and accessories.

1.02 RELATED SECTIONS

- A. Section 16010, General Requirements.
- B. Section 16120, Wire and Cable.
- C. Section 16130, Boxes.
- D. Section 16170, Grounding and Bonding Systems.
- E. Section 16190, Supporting Devices.
- F. Section 16501, Lamps.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01340.
- B. Submit manufacturer's data showing construction, lens, paint finishes, metal gauge, dimensions, etc.

PART 2 - PRODUCTS

2.01 FIXTURES

- A. Fixtures shall be completely factory rewired. Should internal wiring be required, use #14 Type AF wire.
- B. Recessed fixtures shall be in accordance with NEC Article 410.
- C. Fixtures shall be as scheduled in the lighting fixture schedule shown on the drawings. Fixtures shall be by manufacturer and catalog number or approved equal.
- D. Ballast shall be of the proper size and type for the fixtures. Ballast in fluorescent fixtures shall be high power factor, ETL approved and CBM certified, rapid start, low heat type.

Ballast shall be Class "P" rated equipped with an approved internal thermal protective device responsive to ballast temperature which shall open the circuit before damage occurs to ballast.

- E. Fluorescent lighting fixture lens specified by catalog number and/or by descriptive reference shall be acrylic plastic and shall equal or exceed IES-SPI-NEMA test for yellowing factor of not to exceed three after 2,000 hours exposure in a Fade-ometer for the standard test condition.

PART 3 - EXECUTION

3.01 SUPPORTS

All fixtures shall have the necessary studs, straps, fittings, etc., in accordance with manufacturer's installation recommendations, for a complete and safe installation to the proper mounting height required by job conditions. All lay-in fluorescent lighting fixtures shall have wire hanger on adjacent corners on each end (minimum of two hangers) attached to fixture housing and anchored to building structure. Minimum gauge wire shall be 12-gauge steel. In addition to the wire hangers, each lay-in fluorescent fixture shall have earthquake clips for attachments to ceiling grid system. Provide all auxiliary framing required to anchor fixtures to metal building structure in plant.

END OF SECTION

SECTION 16535

SELF-CONTAINED EMERGENCY LIGHTING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

Self-contained emergency building lighting system for emergency exit.

1.02 RELATED SECTIONS

- A. Section 16010, General Requirements.
- B. Section 16120, Wire and Cable.
- C. Section 16130, Boxes.
- D. Section 16170, Grounding and Bonding Systems.
- E. Section 16190, Supporting Devices.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01340.
- B. Submit manufacturer's data showing construction, lens, paint finishes, metal gauge, dimensions, etc.

PART 2 - PRODUCTS

2.01 SURFACE-MOUNTED FIXTURES

- A. Fixtures shall be industrial strength, durable and corrosion-proof.
- B. Housing shall be a NEMA 4X rating for dust-tight, watertight and corrosion-resistant requirement. Housing shall be constructed of fiberglass, reinforced thermoplastic.
- C. Unit shall be completely self-contained, sealed and gasketed.
- D. Lamps: Lamps shall consist of two 8-watt sealed-beam Halogen lamps.
- E. Battery: Maintenance-free nickel cadmium battery.
- F. Push-to-test switch mounted on unit.

PART 3 - EXECUTION

3.01 SUPPORTS

All fixtures shall have the necessary studs, straps, fittings, etc., in accordance with manufacturer's installation recommendations, for a complete and safe installation to the proper mounting height required or specified.

END OF SECTION

SECTION 16600

UNDERGROUND SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install a complete underground system of raceways and pull boxes as shown on the Drawings and as specified herein.
- B. All underground systems shall be direct buried conduit or encased duct bank unless indicated otherwise on the Drawings.
- C. Where referred in this Section, raceways are underground conduits. Underground system is the collection of underground raceways and pull boxes.
- D. Conduit depths vary. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required depths and install raceways at that required depth at no additional cost to the OWNER.
- E. Conduit routing and pullbox locations shown on the Drawings are diagrammatically depicted. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths at no additional cost to the OWNER.

1.02 RELATED WORK

- A. All trenching and surface restoration shall be as specified in Division 2, but the responsibility of furnishing and installing the material shall be that of this Section.
- B. Groundwater control is included in Division 2.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01340, Shop Drawings, Product Data and Samples, for the following:
 - 1. Conduit.
 - 2. Pull boxes.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Raceways shall be polyvinyl chloride conduit. Refer to Section 16111 for material requirements.

-
- B. Ground rods and other grounding materials and methods shall be as specified in Section 16170.
 - C. Bell ends and plastic duct spacers shall be as manufactured by Carlon; Underground Devices Inc. or equal.
 - D. Pull line for spare conduits shall be 1/8 inch nylon rope.
 - E. Detectable Warning Tape
 - 1. Each conduit section shall be marked by means of a detectable warning tape (tracer tape) as shown on the Drawings. The detectable warning tape shall be capable of being detected or located by either conductive or inductive location techniques.
 - 2. The detectable warning tape shall consist of 5 mil (.005 inch) overall thickness; five-ply composition; ultra-high molecular weight; virgin polyethylene; acid; alkaline and corrosion resistant; with 150 lbs of tensile break strength minimum per six inch width.
 - 3. The top side of the tracer tape shall be color banded red for electrical and high voltage lines and orange for signal, communication, telephone and fire alarm lines. Tracer tape shall be four inch wide with four color bands. The tape shall be inscribed with the warning message for the utility such as "CAUTION – ELECTRICAL LINED BURIED BELOW". Tape shall be as manufactured by Mutual Industries, Inc.; Terra Tape, Div. of Reef Industries Inc. or equal.
 - F. Sidewalk boxes and boxes for concrete slabs shall be cast iron intended for outdoor use primarily to provide a degree of protection against falling rain, sleet and external ice formation (NEMA 3R). Boxes shall be manufactured by O-Z/Gedney; Appleton; Killark or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install raceways to drain away from buildings. Raceway slopes shall not be less than three inches per 100 feet.
- B. The minimum cover for raceway banks shall be 24 inches unless otherwise permitted by the ENGINEER.
- C. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings for steel conduit.
- D. Where bends in raceways are required, use long radius elbows, sweeps and offsets.
- E. Swab all raceways clean before installing cable.
- F. Plug and seal spare raceways watertight at all buildings and structures.
- G. Seal the ends of raceways and make watertight at all buildings and structures.

-
- H. Rigid galvanized steel conduit shall be used for elbows and risers at the utility pole for electrical and telephone service conduits. Rigid galvanized steel conduit shall be used for all 90° elbows in the underground conduit duct bank system.
 - I. PVC coated rigid galvanized steel elbows shall be used for pad-mounted transformer stub-ups and all stub-ups through concrete floors, walls and slabs.
 - J. A pull line shall be installed and left in all spare raceways.
 - K. Install detectable warning tape in all trenches as shown on the Drawings. Where trench exceeds 24 inch width, provide additional detectable tape runs to mark each side of the trenches in addition to the one in the center.

3.02 CLEANING

- A. All new pullboxes shall be thoroughly cleaned of all silt, debris and foreign matter prior to final inspection.
- B. After removing old cables, clean out existing ducts to be reused with a duct rodder before installing new cables.
- C. Remove all debris from manholes and handholes after the work is completed.

END OF SECTION

SECTION 16741

TELEPHONE SERVICE SYSTEM (ROUGH-IN)

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Rough-in installation of telephone system backboard, conduit, conductors, and boxes (no telephone equipment will be furnished and installed under this Contract).
- B. Electrical subcontractor shall coordinate all building rough-in requirements, with telephone serving company.

1.02 RELATED WORK

- 1. Section 16111 – Conduit and Fittings
- 2. Section 16130 – Boxes
- 3. Section 16170 – Grounding and Bonding Systems

1.03 SUBMITTALS

Submit under provisions of Section 01340.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Backboard shall be 4' x 8' x $\frac{3}{4}$ " "AD" plywood and shall be painted with 3 coats fire resistant grey paint on both sides and edges.
- B. Conduit, conductors and telephone/data outlets shall be as indicated on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install boxes and telephone/data outlets with same mounting height as receptacles or as noted on drawings.
- B. Telephone backboard shall be installed with long dimension vertical and shall be secure anchored to building wall.
- C. Telephone conduits, and outlets shall not be installed within 6" of any alternating current.

-
- D. Furnish and install all conduit and conductors between backboard and box.

END OF SECTION