PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD

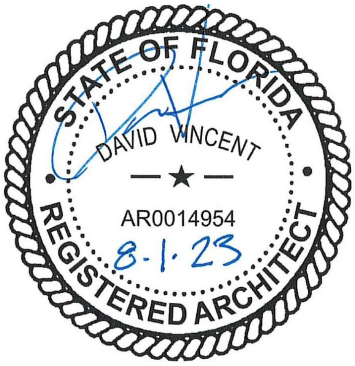
BID DOCUMENTS
AUGUST 1, 2023
PCB 23-48 ITB

VOLUME II

JRA Commission Number – 21804

JRA ARCHITECTS, INC.
2211 Thomas Drive
Suite 100
Panama City Beach, Fl. 32408
(850) 236-9832

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023



SECTION 00 00 00 - TABLE OF CONTENTS

REPORTS AND SURVEYS

1.01 GEOTECHNICAL REPORT

PROCUREMENT AND CONTRACTING REQUIREMENTS

2.01 DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

A. 00 00 00 - Table of Contents
B. 00 01 00 - Advertisement for Bids
C. 00 02 00 - Information for Bidders
D. 00 03 00 - Bid Proposal Form
E. 00 04 00 - Bid Bond
F. 00 05 00 - Agreement
G. 00 06 00 - Performance Bond
H. 00 07 10 - Payment Bond
I. 00 08 00 - Notice of Award
J. 00 09 00 - Notice to Proceed
K. 00 09 20 - Conflict of Interest Statement
L. 00 09 30 - Non-Collusion Affidavit
M. 00 09 40 - E-Verify Form
N. 00 09 50 - Drug-Free Workplace
O. 00 09 60 - Trench Safety Act Compliance
P. 00 09 70 - Public Entity Crimes Statement
Q. 00 09 90 - Insurance Requirements
R. 00 10 00 - General Conditions
S. 00 80 00 - Supplementary Conditions
T. 00 80 80 - Sales Tax Exemption Addendum

SPECIFICATIONS

3.01 DIVISION 01 -- GENERAL REQUIREMENTS

A. 01 04 00 - Coordination
B. 01 04 60 - Special Provisions
C. 01 15 00 - Measurement and Payment
D. 01 25 00 - Substitution Procedures
E. 01 31 00 - Project Coordination
F. 01 32 00 - Project Meetings
G. 01 33 00 - Submittals
H. 01 40 00 - Quality Requirements
I. 01 55 00 - Materials and Equipment
J. 01 57 19 - Erosion Control and Environmental Protection

K. 01 77 00 - Closeout Procedures
L. 01 78 00 - Warranty and Bonds
M. 01 79 00 - Demonstration and Training

3.02 DIVISION 02 -- EXISTING CONDITIONS (NOT USED)

3.03 DIVISION 03 -- CONCRETE

A. 03 11 19 - Insulating Concrete Forming
B. 03 20 00 - Concrete Reinforcing
C. 03 31 00 - Cast-In-Place Concrete

3.04 DIVISION 04 -- MASONRY

A. 04 05 11 - Masonry Mortaring and Grouting
B. 04 20 00 - Reinforced Unit Masonry
C. 04 26 13 - Masonry Veneer
D. 04 72 00 - Cast Stone Masonry

3.05 DIVISION 05 -- METALS

A. 05 12 00 - Structural Steel
B. 05 31 00 - Steel Deck
C. 05 40 00 - Cold-Formed Metal Framing
D. 05 44 00 - Cold-Formed Metal Trusses
E. 05 50 00 - Metal Fabrications
F. 05 52 13 - Pipe and Tube Railings

3.06 DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

A. 06 10 00 - Rough Carpentry
B. 06 17 00 - Engineered Framing System

3.07 DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

A. 07 14 00 - Fluid-Applied Waterproofing
B. 07 21 00 - Thermal Insulation
C. 07 21 29 - Sprayed Insulation
D. 07 24 00 - Exterior Insulation and Finish Systems
E. 07 27 00 - Air Barriers
F. 07 41 13 - Metal Roof Panels
G. 07 46 46 - Fiber-Cement Siding
H. 07 62 00 - Sheet Metal Flashing and Trim
I. 07 84 00 - Firestopping
J. 07 92 00 - Joint Sealants

3.08 DIVISION 08 -- OPENINGS

A. 08 11 13 - Hollow Metal Doors and Frames
B. 08 14 16 - Flush Wood Doors
C. 08 36 13 - Sectional Doors
D. 08 43 13 - Aluminum-Framed Storefronts
E. 08 51 13 - Aluminum Windows

F. 08 56 53 - Security Windows
G. 08 71 00 - Door Hardware
H. 08 80 00 - Glazing

3.09 DIVISION 09 -- FINISHES

A. 09 21 16 - Gypsum Board Assemblies
B. 09 22 16 - Non-Structural Metal Framing
C. 09 30 00 - Tiling
D. 09 51 00 - Acoustical Ceilings
E. 09 65 10 - Resilient Base
F. 09 68 13 - Tile Carpeting
G. 09 91 13 - Exterior Painting
H. 09 91 23 - Interior Painting
I. 09 96 00 - High-Performance Coatings

3.10 DIVISION 10 -- SPECIALTIES

A. 10 14 00 - Signage
B. 10 14 19 - Dimensional Letter Signage
C. 10 26 41 - Ballistics Resistant Panels
D. 10 28 00 - Toilet, Bath, and Laundry Accessories
E. 10 44 00 - Fire Protection Specialties
F. 10 51 13 - Metal Lockers
G. 10 71 13.13 - Exterior Shutters
H. 10 75 00 - Flagpoles

3.11 DIVISION 11 -- EQUIPMENT

A. 11 30 13 - Appliances

3.12 DIVISION 12 -- FURNISHINGS

A. 12 21 13 - Horizontal Louver Blinds
B. 12 32 00 - Manufactured Wood Casework
C. 12 36 00 - Countertops

3.13 DIVISION 21 -- FIRE SUPPRESSION

A. 21 13 13 - Building Sprinkler System

3.14 DIVISION 22 -- PLUMBING

A. 22 01 00 - Plumbing General
B. 22 07 00 - Insulation for Plumbing Pipe and Equipment
C. 22 11 13 - Potable Water System
D. 22 13 16 - Soil, Waste and Vent System
E. 22 16 00 - Gas System
F. 22 30 00 - Plumbing Fixtures, Equipment, Trim & Schedule

3.15 DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

A. 23 01 00 - Mechanical General
B. 23 05 20 - Pipe and Pipe Fittings

C. 23 05 21 - Piping Specialties
D. 23 05 23 - Valves
E. 23 05 29 - Supports, Anchors and Seals
F. 23 05 48 - Vibration Isolation
G. 23 05 53 - Mechanical Identification
H. 23 05 56 - Access Doors
I. 23 05 73 - Excavation and Backfill
J. 23 05 90 - Start-Up Requirements for HVAC Systems
K. 23 05 91 - Testing, Cleaning, and Sterilization of Piping Systems
L. 23 05 93 - Testing and Balancing of Mechanical Systems
M. 23 07 13 - Exterior Insulation for Dutwork
N. 23 07 16 - Insulation for HVAC Equipment and Piping
O. 23 31 13 - HVAC Metal Ductwork
P. 23 33 00 - Ductwork Accessories
Q. 23 34 00 - Fans
R. 23 34 43 - High Volume Low Speed Fans
S. 23 37 13 - Grilles, Registers, and Ceiling Diffusers
T. 23 37 26 - Wall Louvers
U. 23 43 18 - Bi Polar Ionization Air Cleaning Equipment
V. 23 54 16 - Gas-Fired Heating Units
W. 23 81 03 - Outside Air Preconditioning Units
X. 23 81 26 - Air Source Unitary Slpit System Heat Pump Units
Y. 23 81 28 - Ductless Split System Air Conditioning Units
Z. 26 84 16 - Mechanical Dehumidification Units

3.16 DIVISION 26 -- ELECTRICAL

A. 26 05 00 - Electrical General Requirements
B. 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
C. 26 05 23 - Control-Voltage Electrical Power Cables
D. 26 05 26 - Grounding and Bonding for Electrical Systems
E. 26 05 29 - Hangers and Supports for Electrical Systems
F. 26 05 33 - Raceways and Boxes for Electrical Systems
G. 26 05 43 - Underground Ducts and Raceways for Electrical Systems
H. 26 05 44 - Sleeves and Sleeve Seals for Raceways and Cabling
I. 26 05 53 - Identification for Electrical Systems
J. 26 05 73.19 - Arc-Flash Hazard Analysis
K. 26 08 00 - Commissioning of Electrical Systems
L. 26 09 43 - Distributed Intelligence Based Lighting Controls
M. 26 24 16 - Panelboards
N. 26 27 26 - Wiring Devices
O. 26 28 16 - Enclosed Switches and Circuit Breakers

P. 26 32 13.13 - Diesel Emergency Engine Generators
Q. 26 36 00 - Transfer Switches
R. 26 43 13 - Surge Protection for Low-Voltage Power Circuits
S. 26 51 19 - LED Interior Lighting
T. 26 52 13 - Emergency and Exit Lighting
U. 26 56 13 - Lighting Poles and Standards
V. 26 56 19 - LED Exterior Lighting

3.17 DIVISION 27 -- COMMUNICATIONS

A. 27 05 26 - Grounding and Bonding for Communications Systems
B. 27 05 28 - Pathways for Communications Systems
C. 27 05 36 - Cable Trays for Communications Systems
D. 27 11 00 - Communications Equipment Room Fittings
E. 27 13 00 - Communications Backbone Cabling
F. 27 15 00 - Communications Horizontal Cabling
G. 27 51 16 - Public Address Systems

3.18 DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

A. 28 46 21.11 - Addressable Fire-Alarm Systems

3.19 DIVISION 31 -- EARTHWORK

A. 31 20 00 - Earthwork
B. 31 31 16 - Termite Control

3.20 DIVISION 32 -- EXTERIOR IMPROVEMENTS

A. 32 12 16 - Asphaltic Concrete Paving
B. 32 31 13 - Chain Link Fences and Gates
C. 32 31 19 - Decorative Metal Fences and Gates
D. 32 33 13 - Site Bicycle Racks

3.21 DIVISION 33 -- UTILITIES

A. 33 10 00 - Water Distribution System
B. 33 30 00 - Sanitary Sewerage Facilities
C. 33 40 00 - Storm Sewer Collection System

END OF SECTION 00 00 00

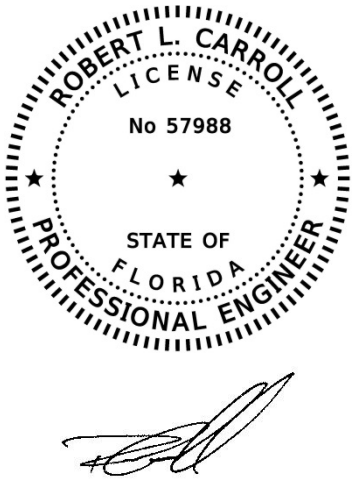
THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

TABLE OF CONTENTS

01 57 19	EROSION CONTROL AND ENVIRONMENTAL PROTECTION
31 20 00	EARTHWORK
32 12 16	ASPHALTIC CONCRETE PAVEMENT
33 10 00	WATER DISTRIBUTION SYSTEM
33 30 00	SANITARY SEWERAGE FACILITIES
33 40 00	STORM SEWER COLLECTION SYSTEM

END OF TABLE OF CONTENTS



THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

Keith A Johnson, State of Florida, Professional Engineer, License No. 86457

This item has been digitally signed and sealed by Keith A Johnson on the date indicated here.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

2023.07.28 09:46:54 -05'00'

KEITH A. JOHNSON LICENSE NO. 86457 STATE OF FLORIDA PROFESSIONAL ENGINEER

TABLE OF CONTENTS

DIVISION 21 FIRE PROTECTION

21 13 13 BUILDING SPRINKLER SYSTEM

DIVISION 22 PLUMBING

22 01 00 PLUMBING GENERAL
22 07 00 INSULATION FOR PLUMBING PIPE AND EQUIPMENT
22 11 13 POTABLE WATER SYSTEM
22 13 16 SOIL, WASTE, AND VENT SYSTEM
22 16 00 GAS SYSTEM
22 30 00 PLUMBING FIXTURES, EQUIPMENT, TRIM & SCHEDULE

DIVISION 23 MECHANICAL

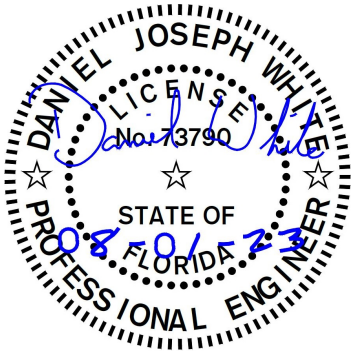
23 01 00 MECHANICAL GENERAL
23 05 20 PIPES AND PIPE FITTINGS
23 05 21 PIPING SPECIALTIES
23 05 23 VALVES
23 05 29 SUPPORTS, ANCHORS, AND SEALS
23 05 48 VIBERATION ISOLATION
23 05 53 MECHANICAL IDENTIFICATION
23 05 56 ACCESS DOORS
23 05 73 EXCAVATION AND BACKFILL
23 05 90 START-UP REQUIREMENTS FOR HVAC SYSTEMS
23 05 91 TESTING, CLEANING, AND STERILIZATION OF PIPING SYSTEMS
23 05 93 TESTING AND BALANCING OF MECHANICAL SYSTEMS
23 07 13 EXTERIOR INSULATION FOR DUCTWORK
23 07 16 INSULATION FOR HVAC EQUIPMENT AND PIPING
23 31 13 HVAC METAL DUCTWORK
23 33 00 DUCTWORK ACCESSORIES
23 34 00 FANS
23 34 43 HIGH VOLUME LOW SPEED FANS
23 37 13 GRILLES, REGISTERS, AND CEILING DIFFUSERS
23 37 26 WALL LOUVERS
23 43 18 BI POLAR IONIZATION AIR CLEANING EQUIPMENT
23 54 16 GAS-FIRED HEATING UNITS
23 81 03 OUTSIDE AIR PRECONDITIONG UNITS
23 81 26 AIR SOURCE UNITARY SPLIT SYSTEMS HEAT PUMP UNIT
23 81 28 DUCTLESS SPLIT SYSTEM AIR CONDITIONG UNITS
23 84 16 MECHANICAL DEHUMIDIFICATION UNITS

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

TABLE OF CONTENTS

SECTION 26 05 00 - ELECTRICAL GENERAL REQUIREMENTS	260500-1 – 260500-8
SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES	260519-1 – 260519-6
SECTION 26 05 23 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES	260523-1 – 260523-8
SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	260526-1 – 260526-8
SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	260529-1 – 260529-6
SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS	260533-1 – 260533-12
SECTION 26 05 43 – UNDERGROUND DUCTS AND RACEWAYS	260543-1 – 260543-8
SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR RACEWAYS & CABLING	260544-1 – 260544-4
SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS	260553-1 – 260553-10
SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS	260573.19-1 – 260573.19-6
SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS	260800-1 – 260800-10
SECTION 26 09 23 – DISTRIBUTED INTELLIGENCE BASED LIGHTING CONTROLS	260943-1 – 260943-16
SECTION 26 24 16 - PANELBOARDS	262416 -1 – 262416-6
SECTION 26 27 26 - WIRING DEVICES	262726-1 – 262726-8
SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS	262816-1 – 262816-8
SECTION 26 32 13.13 - DIESEL EMERGENCY ENGINE GENERATORS	263213.13-1 – 263213.13-18
SECTION 26 36 00 - TRANSFER SWITCHES	263600-1 – 263600-10
SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE POWER CIRCUITS.	264313-1 – 264313-6
SECTION 26 51 19 - LED INTERIOR LIGHTING	265119-1 – 265119-10
SECTION 26 52 13 - EMERGENCY AND EXIT LIGHTING	265213-1 – 265213-6
SECTION 26 56 13 - LIGHTING POLES AND STANDARDS	265613-1 – 265613-8
SECTION 26 56 19 - LED EXTERIOR LIGHTING	265619-1 – 265619-8
SECTION 28 46 21.11 - ADDRESSABLE FIRE-ALARM SYSTEMS	284621.11-1 – 284621.11-16

END OF TABLE OF CONTENTS



PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 21 13 13 BUILDING SPRINKLER SYSTEM

1 GENERAL

1.1 Drawings and General provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Requirements and Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Provide hydraulic calculations and shop drawings for the installation of a wet pipe sprinkler system as shown on the construction documents.

1.4 Quality Assurance: The Sprinkler Contractor shall be qualified as follows:

1.4.1 Experience: The Fire Sprinkler Contractor shall be a registered entity with a minimum history of ten years continuous experience.

1.4.2 Home Office: The home office for the contractor shall be located within 125 miles of the project site.

1.5 Codes and Standards:

1.5.1 State of Florida Codes: Conform to the State of Florida Building Codes including State of Florida Fire Code and State Fire Marshal Rules 69A.

1.5.2 NFPA Compliance: Install fire protection systems in accordance with NFPA 13 "Standard for the Installation of Sprinkler Systems"; and NFPA 96 " Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

1.5.3 UL Compliance: Provide fire protection products in accordance with UL standards; provide UL label on each product.

1.5.4 Fire Department/Marshal Compliance: Install fire protection systems in accordance with local regulations of fire department or fire marshal.

1.5.5 Screw Thread Connections: Comply with local Fire Department/Fire Marshal regulations for sizes, threading and arrangement of connections for fire department equipment to sprinkler systems.

1.6 Submittals

1.6.1 Submit shop drawings and hydraulic calculations in compliance with NFPA 13. Submit component engineering data and finishes for review. Submit design after fire department/fire marshal approval. Submit certifications for designer. Clearly label and exposed piping, system component, or inspection test outlets.

1.7 Test Reports and Verification Submittals:

1.7.1 Certificate: Submit certificates of Aboveground and Underground Installation upon completion of fire protection piping work which indicates that work has been tested in accordance with NFPA 13 and that system is operational, complete, and has no defects.

1.7.2 Tag: Submit a copy of the sprinkler system tag. The installing fire sprinkler contractor shall be licensed in accordance with State Fire Marshal (SFM) Rule 4A-46. At the conclusion of the project and prior to the final inspection by the SFM the Contractor shall tag the fire sprinkler system in accordance with 69A-46.041.

1.8 O&M Data Submittals:

1.8.1 Record Drawings: At project closeout, submit record drawings of installed fire protection piping and products.

1.8.2 Maintenance Data: Submit a copy of all approval submittals. Submit maintenance data and parts lists for basic valves, special valves, etc.

1.8.3 NFPA 25: Provide a copy of NFPA 25 in each O&M Manual.

2 PRODUCTS

2.1 General: Provide materials and factory-fabricated products of sizes, types, pressure ratings, temperature ratings, and capacities as required. Provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in fire protection systems.

3 EXECUTION

3.1 General: Examine areas and conditions under which fire protection materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer. Install the system per NFPA-13 and the requirements of the Authority Having Jurisdiction. Any installation, modification, or alteration of the sprinkler system shall be performed only by a person under a certificate of competency issued by the State Fire Marshal.

3.2 All sprinkler heads in acoustical tile ceilings shall be installed in the center of the tile.

3.3 All sprinklers in finished spaces shall utilize concealed . Coordinate type with Architect.

3.4 Extra Stock:

3.4.1 Heads: For each style and temperature range required, furnish additional sprinkler heads, amounting to one unit for every 100 installed units, but not less than 5 units of each.

3.4.2 Wrenches: Furnish 2 spanner wrenches for each type and size of valve connection and fire hose coupling. Obtain receipt from Owner that extra stock has been received.

3.5 Owner Instruction: Provide technical services for one 4-hour period to instruct Owner's personnel in operation and maintenance of building sprinkler systems.

Schedule training date with Owner. Provide at least 7-day notice to Engineer and Owner of training date.

END OF SECTION 21 13 13

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 22 01 00 - PLUMBING GENERAL

1 GENERAL

1.1 The work covered by this division consists of providing all labor, equipment and materials and performing all operations necessary for the installation of the plumbing work as herein called for and shown on the drawings.

1.2 Related Documents:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. This is a Basic Plumbing Requirements Section. Provisions of this section apply to work of all Division 22 sections.

C. Provisions of all Division-23 Basic Mechanical Requirements Sections apply tow work of all Division 22 sections.

D. Review all other contract documents to be aware of conditions affecting work herein.

E. Definitions:

1. Provide: Furnish and install, complete and ready for intended use.

2. Furnish: Supply and deliver to project site, ready for subsequent requirements.

3. Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

1.3 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.4 Verification of Owner's Data: Prior to commencing any work the Contractor shall satisfy himself as to the accuracy of all data as indicated in these plans and specifications and/or as provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Architect/Engineer in order that proper adjustments can be anticipated and ordered. Commencement by the Contractor of any work shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions or inaccuracies of the said data.

1.5 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage.

1.6 Extent of work is indicated by the drawings, schedules, and the requirements of the specifications. Singular references shall not be constructed as requiring only one device if multiple devices are shown on the drawings or are required for proper system operation.

1.7 Field Measurements and Coordination:

A. The intent of the drawings and specifications is to obtain a complete and satisfactory installation. Separate divisional drawings and specifications shall not relieve the Contractor or subcontractors from full compliance of work of his trade indicated on any of the drawings or in any section of the specifications.

B. Verify all field dimensions and locations of equipment to insure close, neat fit with other trades' work. Make use of all contract documents and approved shop drawings to verify exact dimension and locations.

C. Coordinate work in this division with all other trades in proper sequence to insure that the total work is completed within contract time schedule and with a minimum cutting and patching.

D. Locate all apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on plumbing drawings, be guided by architectural details and conditions existing at job and correlate this work with that of others.

E. Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings and passageways. Cut no structural members without written approval.

F. Carefully examine any existing conditions, piping, and premises. Compare drawings with existing conditions. Report any observed discrepancies. It shall be the Contractor's responsibility to properly coordinate the work and to identify problems in a timely manner. Written instructions will be issued to resolve discrepancies.

G. Because of the small scale of the drawings, it is not possible to indicate all offsets and fittings or to locate every accessory. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate piping, ductwork, equipment and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and for coordination with all trades. Contractor shall not order materials or perform work without such verification. No extra compensation will be allowed because field measurements vary from the dimensions on the drawings. If field measurements show that equipment or piping cannot be fitted, the Architect/Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.8 Guarantee:

A. The Contractor shall guarantee labor, materials and equipment for a period of one (1) year from Final Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary adjustments to and replacement of defective items without expense to the Owner.

B. Owner reserves right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

1.9 Approval Submittals:

A. When approved, the submittal control log and submittals shall be an addition to the specifications herewith, and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1. Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and Division 1 Specification sections and the following.

1.9.1.2 Submittals shall be properly organized in accordance with the approved submittal control log.

1.9.1.3 Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

1.9.1.4 Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.

1.9.1.5 Submittals shall have been reviewed and approved by the General Contractor (or Prime Contractor). Evidence of this review and approval shall be an "Approved" stamp with a signature and date on the cover sheet.

1.9.1.6 Submittals that include a series of fixtures or devices (such as plumbing fixtures or valves) shall be organized by the fixture number or valve type and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether or not those items are used on other fixtures.

1.9.1.7 The electrical design shown on the drawings supports the plumbing equipment basis of design specifications at the time of design. If plumbing equipment is submitted with different electrical requirements, it is the responsibility of the plumbing contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the plumbing submittal with a written statement that this change will be provided at no additional cost. Plumbing submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

B. If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal

cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.

C. Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.

D. Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations and details to scale (not smaller than ¼" per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable. Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final “Approved” or “Approved as Noted” copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required by Division 1 and as described herein.. Submit manuals at the Substantial Completion inspection.

2 PRODUCTS

2.1 All materials shall be new or Owner-supplied reused as shown on the drawings, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.2 Equipment and Materials:

A. Shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.

B. Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated or painted.

C. The label of the approving agency, such as UL, IBR, ASME, ARI, AMCA, by which a standard has been established for the particular item shall be in full view.

D. The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

E. A service organization with personnel and spare parts shall be available within two hours for each type of equipment furnished.

F. Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

G. Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material and type of construction desired. Manufacturer's products shown on the drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products, or the particular products of named manufacturers, meet the detailed specifications and that size and arrangement of equipment are suitable for installation.

H. Model Numbers: Catalog numbers and model numbers indicated in the drawings and specifications are used as a guide in the selection of the equipment and are only listed for the contractor's convenience. The contractor shall determine the actual model numbers for ordering materials in accordance with the written description of each item and with the intent of the drawings and specifications.

2.3 Requests for Substitution:

A. Where a particular system, product or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product or material specified.

B. Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.

1. Required product cannot be supplied in time for compliance with Contract time requirements.

2. Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by Contractor.

3. Substantial cost advantage is offered Owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation and other necessary services and similar considerations.

C. All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows

for both the specified and substituted products:

Principal of operation.
Materials of construction or finishes.
Thickness of gauge of materials.
Weight of item.
Deleted features or items.
Added features or items.
Changes in other work caused by the substitution.
Performance curves.

If the approved substitution contains differences or omissions not specifically called to the attention of the Architect/Engineer, the Owner reserves the right to require equal or similar features to be added to the substituted products (or to have the substituted products replaced) at the Contractor's expense.

3 EXECUTION

3.1 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any materials installed which do not present an orderly and reasonably neat and/or workmanlike appearance, or do not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.2 Coordination:

A. The Contractor shall be responsible for full coordination of the plumbing systems with shop drawings of the building construction so the proper openings and sleeves or supports are provided for piping, ductwork, or other equipment passing through slabs or walls.

B. Any additional steel supports required for the installation of any plumbing equipment, piping, or ductwork shall be furnished and installed under the section of the specifications requiring the additional supports.

C. It shall be the Contractor's responsibility to see that all equipment such as valves, dampers, filters and such other apparatus or equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the drawings.

D. All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

E. The contractor shall protect equipment, material, and fixtures at all times. He shall replace all equipment, material, and fixtures which are damaged as a result of inadequate protection.

F. Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.

G. Start of work will be construed as acceptance of suitability of work of others.

3.3 Interruption of Service: Before any equipment is shut down for disconnecting or tie-ins, arrangements shall be made with the Architect/Engineer and this work shall be done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.4 Phasing: Provide all required temporary valves, piping, ductwork, equipment and devices as required. Maintain temporary services to areas as required. Remove all temporary material and equipment on completion of work unless Engineer concurs that such material and equipment would be beneficial to the Owner on a permanent basis.

3.5 Cutting and Patching: Notify General Contractor to do all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.

3.6 Equipment Setting: Bolt equipment directly to concrete pads or vibration isolators as required, using hot-dipped galvanized anchor bolts, nuts and washers. Level equipment.

3.7 Painting: Touch-up factory finishes on equipment located inside and outside shall be done under Division 22. Obtain matched color coatings from the manufacturer and apply as directed. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.8 Clean-up: Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, contractor is to carefully clean up and leave premises and all portions of building free from debris and in a clean and safe condition.

3.9 Start-up and Operational Test: Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.10 Record Drawings:

A. During the progress of the work the Contractor shall record on their field set of drawings the exact location, as installed, of all piping, ductwork, equipment, and other systems which are not installed exactly as shown on the contract drawings.

B. Upon completion of the work, record drawings shall be prepared as described in the General Conditions, Supplementary Conditions, and Division 1 sections.

3.11 Acceptance:

A. Punch List: Submit written confirmation that all punch lists have been checked and the required work completed.

B. Instructions: At completion of the work, provide a competent and experienced person who is thoroughly familiar with project, for one day to instruct permanent operating personnel in operation of equipment and control systems. This is in addition to any specific equipment operation and maintenance training.

C. Operation and Maintenance Manuals: Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Manuals shall contain:

Detailed operating instructions and instructions for making minor adjustments.
Complete wiring and control diagrams.
Routine maintenance operations.
Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.
Copies of approved submittals.
Copies of all manufacturer's warranties.
Copies of test reports and verification submittals.

D. Record Drawings: Submit record drawings.

END OF SECTION 22 01 00

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 22 07 00 - INSULATION FOR PLUMBING PIPE AND EQUIPMENT

PART 1 GENERAL

1.1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2. Division-22 Basic Plumbing Materials and Methods Sections apply to work of this section.

1.3. Approval Submittals:

A. Product Data: Submit a producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1. Fiberglass pipe insulation

2. Flexible unicellular piping insulation

1.4. O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

2. PRODUCTS

2.1. Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Armstrong, Johns Manville, Knauf, Owens Corning, Pittsburgh Corning, U.S. Rubber, or approved equal. All products shall be asbestos-free.

2.2. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesive) with a flame-spread rating of 25 or less, and a smoke-developed rating of 50 or less, as tested by ANSI/ASTM E84.

2.3. Pipe Insulation Materials:

A. Fiberglass Pipe Insulation: ASTM C547, Class 1 unless otherwise indicated. (Preformed sleeving with white all-service jacket, suitable for temperatures up to 450°F)

B. Flexible Unicellular Pipe Insulation: ASTM C534, Type I. (Tubular, suitable for use to 200ºF.)

C. Staples, Bands, Wires, and Cement: As recommended by the insulation manufacturer for applications indicated.

D. Adhesives, Sealers, Protective Finishes: Products recommended by the insulation manufacturer for the application indicated.

E. Jackets: ASTM C921, Type I (vapor barrier) for piping below ambient temperature, Type II (vapor permeable) for piping above ambient temperature. Type I may be used for all piping at Installer's option.

3. EXECUTION

3.1. General:

A. Install thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on insulation and protect it to prevent puncture and other damage. Label all insulation "ASBESTOS FREE".

D. Do not apply insulation to surfaces while they are hot or wet.

E. Do not install insulation until systems have been checked and found free of leaks. Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.

F. Do not install insulation on pipe systems until acceptance tests have been completed except for flexible unicellular insulation. Do not install insulation until the building is "dried-in".

3.2. Fiberglass Pipe Insulation:

A. Insulate the following piping systems (indoor locations):

Domestic hot water, ≤180° F: up to 2" pipe - 1½" thick, over 2" pipe 2" thick.

Domestic hot water, ≤140° F: up to 3" pipe - 1½" thick, over 3" pipe - 2" thick.

B. Apply insulation to pipe with all side and end joints butted tightly. Seal longitudinal lap by pressurizing with plastic sealing tool. Apply 3 inch wide self sealing butt strips to joints between insulation sections. Insulate all fittings, flanges, valves and strainers with premolded insulation. Apply coat of insulating cement to fittings and wrap with glass cloth overlapping each wrap 1" and adjacent pipe 2". Finish with heavy coat of general purpose mastic. Premolded PVC covers may also be used, but no flexible inserts are allowed.

C. Provide hanger or pipe support shields of 16 gauge (minimum) galvanized steel over the insulation which extends halfway up the pipe insulation cover and at least 6" on each side of the hanger.

D. Omit insulation on exposed plumbing fixture runouts from faces of wall or floor to fixture; on unions, flanges, strainer blowoffs, flexible connections and expansion joints.

3.3. Flexible Unicellular Pipe Insulation:

A. Insulate the following piping systems:

Cold water pipe in unconditioned spaces—1/2” thick.

B. Apply insulation in accordance with the manufacturer's recommendations and instructions. Mitre cut insulation to fit pipe fittings. Use approved cement to seal all joints and ends in the insulation.

END OF SECTION 22 07 00

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 22 11 13 - POTABLE WATER SYSTEM

1. GENERAL

1.1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2. Division-22 Basic Plumbing Requirements and Basic Plumbing Materials and Methods sections apply to work of this section.

1.3. Extent of potable water systems work, is indicated on drawings and schedules, and by requirements of this section.

1.4. Refer to appropriate Division-2 sections for exterior potable water system; not work of this section unless noted.

1.5. Insulation for potable water piping is specified in other Division-22 sections, and is included as work of this section. Insulation requirements include:

A. Domestic hot water piping

B. Cold water piping in unconditioned spaces.

1.6. Excavation and backfill required in conjunction with water piping is specified in other Division-23 sections, and is included as work of this section.

1.7. Code Compliance: Comply with applicable portions of Florida Building Code-Plumbing pertaining to selection and installation of plumbing materials and products. Comply with local utility requirements.

1.8. Approval Submittals:

Product Data: Submit manufacturer's technical product data and installation instructions for:

Valves
Strainers
Hose bibbs
Water hammer arresters
Meters and gauges
Relief valves
Trap primers
Access doors

1.9. Test Reports and Verification Submittals:

A. Disinfection: Submit report by Health Department.

1.10. O&M Data Submittals: Submit a copy of all approval submittals. Submit maintenance data and parts lists for valves, trap primers. Include these data in O&M manual.

2. PRODUCTS

2.1. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with Florida Building Code-Plumbing where applicable. Provide sizes and types matching pipe materials used in potable water systems. Where more than one type of materials or products is indicated, selection is Installer's option.

2.2. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following listed for each item.

2.3. Identification: Provide identification complying with Division-23 Basic Mechanical Materials and Methods section "Mechanical Identification".

2.4. Pipes and Fittings: Provide pipes and pipe fittings complying with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

A. Interior Water Piping:

1. Above Grade: Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.

2. Below Grade: Copper tube; Type L, soft-annealed temper; no joints below floor.

B. Exterior Water Piping:

1. Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.

C. Solder joints shall be made with 95-5 solder.

2.5. Piping Specialties: Provide piping specialties complying with Division-23 Basic Mechanical Materials and Methods section "Piping Specialties".

2.6. Supports and Anchors: Provide supports and anchors complying with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

2.7. Interior Valves: Provide valves complying with Division-23 Basic Mechanical Materials and Methods section "Valves", in accordance with the following listing:

A. Sectional and Shutoff Valves: GA1, GA2, GA3, BA1, BA2.

B. Drain Valves: GA1, GA2, BA1, BA2.

C. Throttling Valves: BA1, BA2.

D. Check Valves: CK1, CK2, CK3.

2.8.

2.9. Hose Bibbs: Provide rough nickel plated hose bibbs with lock shield compression stop and removable handle, solid flange, female connection with ¾" male threaded hose end, and straight line type non-removable vacuum breaker with ¾" male threaded hose end. Acorn 8121 RCP or equal model by Woodford.

2.10. Water Hammer Arresters: Provide bellows type water hammer arresters, stainless steel casing and bellows, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201. Precision Plumbing Products, Josam, Zurn, Amtrol, Wade, Jay R. Smith, or approved equal.

2.11. Meters and Gauges: Provide meters and gauges complying with Division-23 Basic Mechanical Materials and Methods section "Meters and Gauges", in accordance with the following listing:

Thermometers
Pressure gauges
Calibrated balancing cocks

2.12. Combined Pressure-Temperature Relief Valves: Provide relief valves as indicated, of size and capacity as selected by Installer for proper relieving capacity, in accordance with ASME Boiler and Pressure Vessel Code. Provide bronze body, test lever and thermostat complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210°F, and pressure relief at 150 psi. Watts, Cash, Zurn, or approved equal.

2.13. Trap Primers: Provide brass trap primers and distribution units to seal floor drains indicated on drawings. Trap primer valves shall be automatic, self contained type with no springs or diaphragms and shall not require adjustment. Trap primer valves shall be the type that can be installed anywhere on cold water piping. Distribution units shall supply 1-4 floor drains. Trap primer valves shall comply with ASSE 1018. Precision Plumbing Products PR-500, or approved equal. Where P-trap primers are indicated use "Prime-Eze" by Jay R. Smith, or approved equal.

2.14. Access Doors: Provide access doors to service all valves and other devices as required in accordance with Division-22 Basic Materials and Methods Section “Access Doors”.

3. EXECUTION

3.1. General: Examine areas and conditions under which potable water systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2. Install plumbing identification in accordance with Division-23 Basic Mechanical Materials and Methods section "Mechanical Identification".

3.3. Install water distribution piping in accordance with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

A. Install piping with 1/32" per foot (¼%) downward slope towards drain point.

B. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

3.4. Install piping specialties in accordance with Division-23 Basic Mechanical Materials and Methods section "Piping Specialties".

3.5. Install supports and anchors in accordance with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

3.6. Install valves in accordance with Division-23 Basic Mechanical Materials and Methods section "Valves".

A. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two or more plumbing fixtures or equipment connections, and elsewhere as indicated.

B. Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.

C. Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain potable water system.

D. Check Valves: Install where indicated.

E. Calibrated Balancing Cocks: Install in each hot water recirculating loop, and elsewhere as indicated.

3.7. Hose Bibbs and Wall Hydrants: Install on concealed piping where indicated with vacuum breaker. Mount 18 inches above grade or finished floor.

3.8. Install meters and gauges in accordance with Division-23 Basic Mechanical Materials and Methods section "Meters and Gauges".

3.9. Install relief valves on each water heater, and where indicated in accordance with the manufacturer's instructions. Pipe full size outside or to floor drain. Cut the end of the pipe at a 45° angle and terminate 6 inches above the floor or grade.

3.10. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Florida Building Code-Plumbing.

3.11. Plumbing Equipment Connections: Connect hot and cold water piping system to plumbing equipment as indicated, and comply with equipment manufacturer's installation instructions. Provide shutoff valve and union for each connection, provide drain valve on drain connection.

3.12. Install water hammer arresters in upright position, in locations and of sizes indicated in accordance with PDI Standard WH-201.

3.13. Install trap primers as indicated, and in accordance with manufacturer's installation instructions. Provide access panels to all trap primers unless accessible through a lay-in ceiling.

3.14. Locate and coordinate installation of access doors for all valves and devices in accordance with Division-23 Basic Mechanical Materials and Methods section “Access Doors”.

3.15. Piping Tests: Test, clean, and sterilize potable water piping in accordance with testing requirements of Division-23 Basic Mechanical Materials and Methods section "Testing, Cleaning, and Sterilization of Piping Systems".

END OF SECTION 22 11 13

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 22 13 16 - SOIL, WASTE, AND VENT SYSTEM

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-22 Basic Plumbing Requirements and Basic Plumbing Materials and Methods sections apply to work of this section.

1.03 Extent of soil waste and vent systems work is indicated on drawings and schedules, and by requirements of this section.

1.04 Refer to appropriate Division-2 sections for exterior sanitary sewer system required in conjunction with soil and waste systems; not work of this section.

1.05 Insulation for soil and waste systems is specified in other Division-22 sections, and is included as work of this section. Insulation requirements include:

A. Horizontal above grade waste pipes receiving discharge from ice machines, coolers, freezers or similar units to points of connection receiving waste from 4 or more fixtures.

B. Horizontal above grade waste pipes receiving condensate from air conditioning equipment to point of connection receiving waste from 4 or more fixtures.

1.06 Excavation and backfill required in conjunction with soil, waste and vent piping is specified in other Division-23 sections and is included as work of this section.

1.07 Refer to Division-7 section "Flashing and Sheet Metal" for flashings required in conjunction with soil and waste systems; not work of this section.

1.08 Code Compliance: Comply with applicable portions of Florida Building Code-Plumbing pertaining to plumbing materials, construction and installation of products. Comply with local utility requirements.

1.09 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data for:

Cleanouts
Floor drains

1.10 O&M Data Submittals: Submit a copy of all approval submittals. Include these data in O&M manual.

PART 2 PRODUCTS

2.01 General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in soil and waste systems. Where more than one type of materials or products is indicated, selection is Installer's option.

Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SEWER LINE BURIED BELOW".

2.02 Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following listed for each item.

2.03 Pipes and Fittings: Provide pipes and pipe fittings complying with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

A. Above Ground Soil, Waste, and Vent Piping:

1. Polyvinyl chloride plastic pipe (PVC); Type DWV; PVC plastic type DWV socket-type fitting, solvent cement joints. Do not use in fire-rated assemblies or return air plenums.

B. Underground Building Drain Piping (within 5 feet of the building):

1. Pipe Size 6" and Smaller: Polyvinyl chloride sewer pipe (PVC); Type DWV; PVC plastic type DWV socket-type.

2.04 Pipe Specialties: Provide piping specialties complying with Division-22 Basic Materials and Methods section "Piping Specialties".

2.05 Supports and Anchors: Provide supports and anchors complying with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

2.06 Cleanouts: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations. Josam, Jay R. Smith, Wade, Zurn.

A. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1 countersunk head.

B. Cleanout for PVC Systems:

1. Floor Cleanouts: Cast-iron body with adjustable head, brass plug, and scoriated nick-brass cover. Furnish with carpet flange for carpeted floors. Furnish with recessed cover for tile floors. Furnish with clamping ring for floors with membrane. Wade W-6030 hub outlet for push-on.

2. Cleanouts in Piping: PVC cleanout adaptor with threaded PVC plug.

3. Wall Cleanouts: PVC cleanout adaptor with tapped, countersunk,

threaded brass plug. Square 8.75”x8.75” hinged wall access cover, with scoriated nickel bronze finish.

4. Grade Cleanouts: PVC cleanout adaptor with countersunk, threaded brass plug. Wade W-8590-D plug. In sidewalks and other finished concrete, provide access cover frames with a non-tilting tractor cover. Wade W-7035-Z or equal.

5. Cleanouts in Paved Areas: Cast iron body, adjustable housing, ferrule with plug and round loose scoriated tractor cover. Wade W-8300-MF. Coordinate concrete depth at site with adjustable flange.

2.07 Floor Drains: Provide floor drains of size as indicated on drawings; and type, including features, as specified herein. Josam, Jay R. Smith, Wade, Zurn.

A. Floor Drains: Provide inside caulk bottom outlet or TY-Seal hub outlet with adaptor for cast iron trap installation and a 4" deep trap seal. Provide clamping rings for floors with membrane.

B. Strainer: Provide 5" satin-nickel bronze strainer.

C. Trap Primer Connection: Provide ½" trap primer tapping.

D. Funnel: Provide funnel where shown on the drawings.

E. Basis of Design: Wade Series 1100.

PART 3 EXECUTION

3.01 Examine substrates and conditions under which soil and waste systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 Piping Installation:

A. Install above grade soil and waste piping in accordance with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings", and with Florida Building Code-Plumbing.

B. Install underground soil and waste pipes as indicated and in accordance with Florida Building Code-Plumbing. Lay underground piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

C. Install building soil and vent piping pitched to drain at minimum slope of ¼" per foot (2%) for piping smaller than 3", and 1/8" per foot (1%) for piping 3" and larger.

3.03 Install piping specialties in accordance with Division-23 Basic Mechanical Materials

and Methods section "Piping Specialties".

3.04 Install supports and anchors in accordance with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

3.05 Installation of Cleanouts: Install in above ground piping and building drain piping as indicated, as required by Florida Building Code-Plumbing; and at each change in direction of piping greater than 45°; at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

A. Size: Cleanouts shall be full size up to 4". Piping over 4" shall have a reducing fitting to accommodate a 4" cleanout unless indicated otherwise on drawings.

B. Install cleanouts to allow adequate clearance for rodding.

C. Protect all finished surfaces of cleanouts with a suitable adhesive covering until construction is completed.

D. Cleanouts to Grade: Provide an 18" x 18" x 8" thick concrete pad around the cleanout. Set the cleanout ferrule, adapter, or access cover frame in the concrete as required. The cleanout shall be extended to the finished grade. The concrete pad shall slope away from the cleanout in all directions approximately one inch. Cover pad with fill to finished grade.

E. Cleanouts in Paved Areas: Provide concrete pad similar to cleanout to grade and coordinate concrete depth at site with adjustable flange. Access cover frames are required.

3.06 Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

3.07 Vent Flashing Sleeves: Install on stack passing through roof, secure to stack flashing in accordance with manufacturer’s instructions. For metal roofs, sleeves and flashing are by Division-7.

3.08 Installation of Floor Drains: Install floor drains in accordance with manufacturer's written instructions and in locations indicated.

A. Coordinate flashing work with work of waterproofing and adjoining substrate work.

B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

C. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

D. Position drains so that they are accessible and easy to maintain.

3.09 Connection of Trap Primers: Connect trap primers as indicated, and in accordance with manufacturer's installation instructions. Pitch piping towards drain trap, minimum

of 1/8" per foot (1%). Adjust trap primer for proper flow.

3.10 Piping Runouts to Fixtures: Provide soil and waste piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but in no case smaller than required by Florida Building Code-Plumbing.

3.11 Test, clean, flush, and inspect soil and waste piping in accordance with requirements of Division-23 Basic Mechanical Materials and Methods section "Testing, Cleaning and Sterilization of Piping Systems".

END OF SECTION 22 13 16

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 22 16 00 - GAS SYSTEM

PART 1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

1.2 Division-22 Basic Plumbing Requirements and Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.4 Extent of fuel gas systems work, is indicated on drawings and schedules, and by requirements of this section.

1.5 Excavation and backfill required in conjunction with gas service piping is specified in Division-23 sections, and is included as work of this section.

1.6 Codes and Standards

1.6.1 NFPA Compliance: Fabricate and install gas systems in accordance with NFPA 54 "National Fuel Gas Code".

1.6.2 Utility Compliance: Fabricate and install gas systems in accordance with local gas utility company requirements and standards.

1.7 Approval Submittals:

1.7.1 Product Data: Submit manufacturer's technical product data and installation instructions as follows:

Gas cocks and/or ball valves
Gas vents
Gas regulators
Access doors

1.8 O&M Data Submittals: Submit a copy of approval submittals. Submit maintenance data and parts lists for gas cocks, ball valves, gas vents, regulators. Include these data in O&M manual.

PART 2 PRODUCTS

2.1 General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with NFPA 54 where applicable. Base pressure rating on gas piping system maximum design pressures. Provide sizes and

types matching piping and equipment connections; provide fittings of materials which match pipe materials used in gas systems. Where more than one type of materials or products are indicated, selection is Installer's option.

2.2 Identification: Provide identification complying with Division-23 Basic Mechanical Materials and Methods section "Mechanical Identification".

2.3 Pipes and Fittings: Provide pipes and pipe fittings complying with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

2.3.1 Gas Service Piping: Refer to civil site utility plans.

2.3.2 Building Distribution Piping:

2.3.2.1 Pipe Size 2" and Smaller: Black steel pipe; Schedule 40; malleable-iron threaded fittings.

2.3.2.2 Pipe Size 2½" and Larger: Black steel pipe; Schedule 40; wrought-steel buttwelding fittings.

2.4 Piping Specialties: Provide piping specialties complying with Division-23 Basic Mechanical Materials and Methods section "Piping Specialties".

2.5 Sealants: Provide UL-listed or AGA approved sealants for gas piping.

2.6 Supports and Anchors: Provide supports and anchors complying with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

2.7 Valves: Provide valves complying with Division-23 Basic Mechanical Materials and Methods section “Valves” and in accordance with the following listing.

2.7.1 Gas Cocks 2" and Smaller: UL-listed, AGA approved, 150 psi non-shock WOG, full port, bronze straightway cock, flat or square head, threaded ends.

2.7.2 Gas Cocks 2½" and Larger: UL-listed, CGA approved, MSS SP-78; 175 psi, lubricated plug type, full port, semi-steel body, single gland, wrench operated, flanged ends.

2.7.3 Wrenches: Provide operating wrenches for all gas cocks serving boilers.

2.7.4 Acceptable Manufacturers for gas cocks: Subject to compliance with requirements, provide products of one of the following: Resun R1430 and R1431, Milliken 200M and 201M or approved equal.

2.8 Kitchen Gas Appliance Connectors: Furnished with the kitchen equipment.

2.9 Gas Appliance Tube Connectors: Provide commercial grade appliance connectors with a 2 year manufacturer’s warranty. Tubing shall be Type 304 stainless steel tubing with type 304 stainless steel braiding to protect tubing from elongation. Tubing shall be complete with factory installed end connectors. Provide products that are AGA or CGA approved. Indicate maximum BTU input for each length and size used on submittal.

2.10 Gas Meter and Regulator: Provided by local utility company.

2.11 Access Doors: Provide access doors to service all valves and other devices as required in accordance with Division-23 Basic Materials and Methods Section “Access Doors”.

PART 3 EXECUTION

3.1 Examine areas and conditions under which gas systems materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer. Coordinate with gas supplier prior to starting work.

3.2 Install mechanical identification in accordance with Division-23 Basic Mechanical Materials and Methods section "Mechanical Identification".

3.3 Install gas piping in accordance with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings".

3.3.1 Use sealants on metal gas piping threads which are chemically resistant to gas. Use sealants sparingly, and apply to only male threads of metal joints.

3.3.2 Remove cutting and threading burrs before assembling piping.

3.3.3 Do not install defective piping or fittings. Do not use pipe with threads which are chipped, stripped or damaged. Do not use bushings in the gas system.

3.3.4 Plug each gas outlet, including valves, with threaded plug or cap immediately after installation and retain until continuing piping, or equipment connections are completed.

3.3.5 Ground gas piping electrically and continuously within project, and bond tightly to grounding connection.

3.3.6 Install drip-legs in gas piping where indicated, and where required by code or gas company requirements.

3.3.7 Install "Tee" fitting with bottom outlet plugged or capped, at bottom of pipe risers.

3.3.8 Use dielectric unions where dissimilar metals are joined together.

3.3.9 Install piping with 1/64" per foot (1/8%) downward slope in direction of flow.

3.4 Gas Service: Arrange with utility company to provide gas service to indicated location with meter, pressure regulator and shutoff at terminus. Consult with utility as to extent of its work, costs, fees, and permits involved. The Contractor shall pay such costs and fees and obtain permits.

3.5 Install piping specialties in accordance with Division-23 Basic Mechanical Materials and Methods section "Piping Specialties".

3.6 Install supports and anchors in accordance with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

3.7 Installation of Valves:

3.7.1 Gas Cocks: Provide at connection to gas train for each gas-fired equipment item; and on risers and branches where indicated.

3.7.2 Locate gas cocks where easily accessible, and where they will be protected from possible injury.

3.8 Equipment Connections: Connect gas piping to each gas-fired equipment item, with drip leg and shutoff gas cock. Comply with equipment manufacturer's instructions.

3.9 Appliance Connectors: Install tubing, valves, connectors, fittings in accordance with their listing and as furnished with the kitchen equipment. Hose, fittings and valves shall not restrict gas flow and shall be rated for the capacity of the appliance they serve. Hoses shall not be crimped. Hoses behind movable appliances shall not be crimped when appliance is extended from wall or when appliance is set in working position. Appliance restraining device shall set to engage just prior to the connector being fully extended. Check all tubing, piping, fittings & valves for leakage at less than 50 part per million.

3.10 Locate and coordinate installation of access doors for all valves and devices in accordance with Division-23 Basic Mechanical Materials and Methods section “Access Doors”.

3.11 Piping Tests: Inspect, test, and purge gas systems in accordance with NFPA 54, local utility requirements, and Division-23 Basic Mechanical Materials and Methods section "Testing, Cleaning and Sterilization of Piping Systems". DO NOT INTRODUCT AIR INTO THE SYSTEM, VENT OR PURGE WITH NITROGEN. DISCHARGE VENT OR PURGE GASES TO THE EXTERIOR OF THE BUILDING.

END OF SECTION 22 16 00

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 22 30 00 - PLUMBING FIXTURES, EQUIPMENT, TRIM & SCHEDULE

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-22 Basic Plumbing Requirements and Basic Plumbing Materials and Methods sections apply to work of this section.

1.03 Extent of plumbing fixtures work required by this section is indicated on drawings and schedules, and by requirements of this section.

1.04 Refer to Division-26 sections for field-installed electrical wiring required for plumbing fixtures; not work of this section.

1.05 Codes and Standards:

A. Plumbing Fixture Standards: Comply with applicable portions of Florida Building Code-Plumbing pertaining to materials and installation of plumbing fixtures.

B. ANSI Standards: Comply with applicable ANSI standards pertaining to plumbing fixtures and systems.

C. PDI Compliance: Comply with standards established by PDI pertaining to plumbing fixture supports.

D. UL Listing: Construct plumbing fixtures requiring electrical power in accordance with UL standards and provide UL-listing and label.

E. ARI Compliance: Construct and install water coolers in accordance with ARI Standard 1010 "Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers", and provide Certification Symbol.

F. ANSI Compliance: Construct and install barrier-free plumbing fixtures in accordance with ANSI Standard A117.1 "Specifications for Making Buildings and Facilities Accessible To and Usable By Physically Handicapped People".

1.06 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, furnished specialties and accessories; and installation instructions. Submit manufacturer's assembly-type drawings indicating dimensions, roughing-in requirements, required clearances, and methods of assembly of components and anchorages. The submittal shall be organized by “fixture number” and each fixture package shall be so identified. Each fixture package shall include all of the required fitting and trim, even if such devices are used for more than one fixture.

1.07 O&M Data Submittals: Submit a copy of approval submittals. Submit maintenance data and parts lists for each type of plumbing fixture and accessory; including "trouble-shooting" maintenance guide. Include these data in O&M manual.

1.08 Handle plumbing fixtures carefully to prevent breakage, chipping and scoring fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

PART 2 PRODUCTS

2.01 General: Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture, provide trim, carrier, seats, and valves as specified. Where not specified, provide products as recommended by manufacturer, and as required for complete installation. Where more than one type is indicated, selection is Installer's option; but, all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

2.02 Model Numbers: Basis of design model numbers of a particular manufacturer are listed in the fixture schedule as an aid to contractors. Where conflicts between the model number and the written description occur, the written description shall govern. Where acceptable manufacturers are listed, products are subject to compliance with requirements.

2.03 Materials:

A. Provide materials which have been selected for their surface flatness and smoothness. Exposed surfaces which exhibit pitting seam marks, roller marks, foundry sand holes, stains, decoloration, or other surface imperfections on finished units are not acceptable.

B. All fixtures shall be white vitreous china unless otherwise specifically noted. Where enameled iron fixtures are specified, they shall be furnished with acid resisting enamel.

C. Where fittings, trim and accessories are exposed or semi-exposed provide bright chrome-plated or polished stainless steel units. Provide copper or brass where not exposed.

D. Stainless Steel Sheets: ASTM A 167, Type 302/304, hardest workable temper. Finish shall be No. 4, bright, directional polish on exposed surfaces.

E. Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes and specks; glaze exposed surfaces, and test for crazing resistance in accordance with ASTM C 554.

F. Synthetic Stone: High quality, free from defects, glaze on exposed surfaces, stain resistant.

2.04 Plumbing Fittings, Trim and Accessories:

A. Faucets: At locations where water is supplied (by manual, automatic or remote control), provide commercial quality chrome-plated, cast-brass faucets, valves, or other dispensing devices, of type and size indicated, and as required to operate

as indicated.

1. Aerators: Provide aerators of types approved by Health Department having jurisdiction.

2. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. American Standard, Chicago Faucet Co., Kohler Co., Speakman Co., T & S Brass and Bronze Works, Water Saver Faucet Co.

B. Stops: Provide chrome-plated brass, angle type, manual shutoff valves and d" chrome-plated flexible supply pipes to permit fixture servicing without shutdown of water supply piping systems for all fixtures. Coordinate with fixture requirements.

1. Provide standard stops.

2. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Zurn or approved equal.

C. Waste Outlets: Provide removable P-traps, drains, waste arms, tailpieces and wastes-to-wall where drains are indicated for direct connection to drainage system for all fixtures unless otherwise noted. Provide drains, tailpieces and waste arms where indirect drains are indicated. Waste outlets shall be full size of fixture drain connection.

1. Provide chrome-plated cast-brass P-traps and drains with cleanout.

2. P-traps, wastes and drains of all types shall be 17-gauge.

3. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Zurn, or approved equal.

D. Carriers: Provide cast-iron supports for fixtures of either graphitic gray iron, ductile iron, or malleable iron or steel as indicated. Coordinate with specific fixture requirements and conditions of the project.

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Josam, Wade, Zurn, J.R. Smith.

E. Fixture Bolt Caps: Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

F. Escutcheons: Where fixture supplies and drains penetrate walls in exposed locations, provide chrome-plated brass escutcheons with friction clips.

G. Comply with additional fixture requirements listed for each fixture and as required for a complete and functional system.

2.05 Water Closets:

A. General: Provide white china siphon jet type unless otherwise noted.

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. American Standard, Crane, Kohler, or Zurn.

B. Fixture Seats: Provide white, heavy molded plastic fixture seats with stainless steel self-sustaining check hinges.

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Bemis Mfg. Co., Beneke Corp., Church or Comfort Seats.

C. Water Closet Schedule:

WC-1 WATER CLOSET, FLOOR-MOUNT (HANDICAP, MANUAL VALVE):

Vitreous china, 1.28 gallons per flush, elongated, high efficiency siphon jet, white, water saver bowl with 1-1/2" top spud, 17" high for handicapped. Exposed chrome plate flush valve, with screwdriver stop, vacuum breaker, quiet flush feature, with sweat solder kit and cast wall flange. Heavy molded plastic, white, elongated, open front seat less cover, with stainless steel, self-sustaining check hinges. Hold centerline flush valve assembly off finish wall for grab bar clearances, coordinate with Architectural drawings.

Water closet	Zurn Z5665BWL
Valve	Zurn Z6000PL-HET
Seat	Z5955SS-EL-STS
Closet Bolt/Wax Ring Kit	Z5972-COMB

2.06 Lavatories:

A. General: Provide white china lavatories.

B. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. American Standard, Crane, Kohler, or Zurn.

C. Lavatory Schedule: - Refer to Fixture Schedule on Drawing

L-1 LAVATORY, COUNTERTOP:

Vitreous china 20" x 17", oval, color “white”, 4” centers, front overflow. Provide chrome plated angle stop to wall with chrome plated 3/8" flexible supply and loose key operator, integral perforated cast brass strainer with 1-1/4" tailpiece, chrome plated 17 gauge cast brass P-trap with cleanout and tube waste to wall. Polished chrome plated metal faucet with ceramic disc valve with cover plate, and straight handle. Under sink mixing valve with soldered connection, bronze body, limits hot water between 80ºF & 120ºF, double throttling, integral inlet filter washers & check valves, tamper resistant locking cap. Meets ASSE 1070 standards.

Lavatory	Zurn Z5114
Faucet	Kohler K-45100-4
Supply w/stop	Zurn 8800LRLK-PC

P-Trap	Zurn Z8700-PC
Drain	Zurn Z8743-PC
Mixing Valve	Watts MMV-US-M1

L-2 LAVATORY, WALL-MOUNT (HANDICAP):

Vitreous china 20" x 18", color “white”, 4” centers, front overflow, for concealed arm support. Furnish floor-mounted single carrier with concealed arms, leveling and securing screws, structural uprights and block bases, secure base to floor for rigid connection with 1/2" x 3-3/4" threaded zinc plated steel heavy duty wedge anchors, complete with stainless steel clip, washer and threaded nut, conforming to federal spec. FF-S-325. Provide chrome plated angle stop to wall with chrome plated 3/8" flexible supply and loose key operator, integral perforated cast brass strainer with elbow and 1-1/4" offset tailpiece, chrome plated 17 gauge cast brass P-trap with cleanout and tube waste to wall. Polished chrome plated metal faucet with ceramic disc valve with cover plate, and straight handle. Lavatory P-trap and angle valve assemblies shall be insulated with fully molded insulation kit, and light gray color with 3-piece interlocking rap assembly and 2-piece interlocking angle valve assembly. Fasteners shall be nylon-type supplied with kit. Lavatory shall be mounted with a clearance of at least 28" from floor to bottom of the apron. Knee and toe clearances shall be as follows: 27" clear height shall be provided from finished floor to a point on underside of bowl 8" in from front apron. Toe clearance shall be a minimum height of 9" under P-trap and supplies or stops. See Architectural drawings for final mounting height. Under sink mixing valve with soldered connection, bronze body, adjustable hot water limit between 80ºF & 120ºF, double throttling, integral inlet filter washers & check valves, tamper resistant locking cap. Meets ASSE 1070 standards.

Lavatory	Zurn Z5344
Faucet	Kohler K-45100-4
Supply w/stop	Zurn Z8800LRLK-PC
P-Trap	Zurn Z8700-PC
Strainer/tailpiece	Zurn Z8746
Insulation kit	Zurn Z8946-3-NT
Carrier	Zurn Z-1231
Base Anchorage	B-Line Anchors AWA-50-375
Mixing Valve	Watts MMV-US-M1

2.07 Electric Water Coolers:

A General: Provide self-contained electric water cooler with entire water system free of lead. All joints shall be made using silver solder. Units shall be complete with an air-cooled refrigeration system consisting of a hermetic compressor, cooler, pre-cooler, condenser fan, thermostat safety controls and all other related devices. The unit shall have a capacity of 8 gallons per hour. The cabinet shall be stainless steel with vermin proof insulation. The top shall be fabricated of stainless steel with a No. 4 finish. Where handicap units are indicated, the bubbler and fountain shall be ADA compliant.

B Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Elkay Mfg. Co., Halsey Taylor Div., Haws Drinking Faucet Co., Sunroc, Oasis.

C Electric Water Cooler Schedule:

EWC-1 ELECTRIC WATER COOLER(SINGLE LEVEL/BOTTLE STATION):

Wall hung, ADA, self-contained single level electric water cooler with sensor activated bottle filling station. Furnish floor-mounted single carrier with bearing plate, hanger plate. Adjustable supporting rods, structural uprights and block bases. Unit to be complete with hermetic air-cooled refrigeration system, cooler pre-cooler, thermostat, safety controls, condenser fan motor, silver ion antimicrobial protection on key plastic components, flexi-guard safety bubbler, visual filter monitor, vermin proof insulation, stainless steel cabinet, quiet operation. Top of cooler shall be No. 3 finish stainless steel, Cooler capacity shall be 8.0 gph, cooling 80-degree F water to 50 degree F. Provide one-year warranty on entire cooler. See Architectural drawings for mounting height. Provide chrome plated 1/2" IPS x 3/8"OD, loose key operated, angle stop to wall with chrome plated 3/8" flexible copper risers. Provide 1-1/4" chrome plated 17 gauge cast brass P-trap with cleanout and tube waste to wall. 120V, single phase, 6.0 full load amps, 370 rated watts, 1/6 compressor hp. Verify final location, mounting height and finish with Architectural drawings. Water cooler shall be Certified to NSF/ANSI 42, 53, 61, & 372. UL 399 requirements.

EDF	Elkay LZSTL8WSSK
P-trap	Zurn Z-8702-PC
Carrier	Zurn Z-1225
Supplies	Zurn Z-8802-LR-LK

2.08 Mop Receptors:

A. General: Provide one piece mop receptors with 3" integral stainless steel grid drain. Provide wall-mounted faucet with arm handles, vacuum breaker, stops, hose connection and hose bracket. Provide 30" hose.

B Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Stern-Williams Co., or Acorn.

C. Mop Receptor Schedule:

MR-1 SERVICE SINK (FLOOR TYPE):

24" x 24" x 12" deep, floor mount, terrazzo with 20 gauge stainless steel integral cast cap, 3" cast brass outlet drain with stainless steel strainer, 36" hose with wall hanger, and mop hanger with 3 grips on a stainless steel bracket. Rough chrome plated 8" faucet with top brace, straight lever handles, swivel inlets, bucket hook, vacuum breaker, stops and hose end.

Sink	Acorn TSH24-KH36-KMH
Faucet	Zurn Z843 M1 RC

2.09 Stainless Steel Sinks:

A. General: Provide Type 304, 18 gauge self-rimming stainless steel back ledge with No. 4 finish . Provide sound deadening material on the sides and bottom of the sink. Provide grid drain or strainer with removable crumb cup and stopper as indicated.

B. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Elkay, Just

C. Stainless Steel Sink Schedule:

SK-1 TRIPLE COMPARTMENT STAINLESS STEEL SINK:

63" x 22" x 10" deep (bowl is 19x16x10), type 304, 18 gauge, self rimming triple compartment, (18-8) nickel bearing stainless steel, two single hole faucet holes, back ledge sink with satin finish and sound deadening materials on side and bottom of sink. Provide two top mount swing faucets with stainless finish. Each faucet shall have a single hole mount, pull down sprayhead with touch controls, removable coil, single lever handle, vacuum breaker, 1.5 GPM compensating aerator. Each bowl shall include strainer with removable crumb cup and stopper, 1-1/2 tailpiece, chrome plated brass 1-1/2" continuous waste with end outlet and 1-1/2" tailpiece, chrome plated 17 gauge cast brass P-trap with cleanout and tube waste to wall. Chrome plated loose key angle stop to wall with 3/8" chrome plated flexible hot and cold water supplies. Coordinate with cabinet shop drawings, base cabinet must be a true minimum 24" deep back to front in order for sink to drop into countertop opening. Sink drillings shall accommodate fitting installation, only, no other capped openings will be allowed. Provide under sink disposal with 1/3 HP motor.

Sink	Elkay LTR632210
Faucet	Kohler K-29106
Strainer	Elkay LK-35
Waste	Elkay LK-53
Supplies	Zurn Z-8800-LR-LK
P-trap	Zurn Z-8702-PC
Disposal	GE GFC320V

2.10 Showers:

A. General:

B. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Leonard Valve Co., MCC Powers Process Controls, Symmons, Speakman Co.

C. Shower Schedule:

SH-1 SHOWER (HANDICAP):

Single handle pressure-balancing mixing valve. Ceramic control cartridge with stainless steel balancing piston. Must hold shower temperature steady with pressure fluctuations up to 85%. packing with Brass adjustable limit stop screw to prohibit valve handle from being turned to excessive hot discharge temperatures. All trim to be copper nickel chrome plated. Service stops to be brass and cast integral with valve body. Two way chrome diverter valve. Brass shower head with arm and flange. Wall/hand shower with flexible metal hose, in-line vacuum breaker, wall connection and flange, 30" slide bar for hand shower mounting.

Shower	Zurn Z-7301-SS-MT-DV-2P-HW
Drain	Zurn ZN-415 2" with 5" B

2.11 Water Heaters:

A. Gas Water Heaters:

B. Accessories: VB, relief, pan, stand, etc.

C. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. Ruud, Rheem, Mor-Flo, State, A.O. Smith.

D. Water Heater Schedule:

GWH-1 GAS FIRED WATER HEATER:

Packaged atmospheric gas vertical packaged water heater with glass lined storage tank, minimal thermal efficiency @97%. Storage capacity @ 100 gallons, rated for 199,900 btu/hr input, recovery @336 gph, 70 degree F temp. rise, 150 P.S.I. working pressure, ASME constructed, minimum three year warranty. Furnish 115 volt, single phase electrical characteristics, for controlled electric ignition sequence. Provide galvanized steel safety drip pan and vertical direct vent. Provide inlet and outlet shut-off valves, vacuum relief valve on inlet water supply. Provide precharged expansion tank, outer steel shell (flexible diaphragm type), on cold water inlet side of water heater for thermal expansion control, tank volume in gallons shall be of sufficient size to accommodate water heater size in gallons.

Water heater	A. O. Smith BTH 120
Vacuum relief	Watts 36A
Expansion tank	Amtrol “Therm-X-Trol”
Manifold kit	A.O. Smith 9003426205

IWH-1 INSTANTANEOUS WATER HEATER:

Natural gas, outdoor tankless water heater with integrated recirculation pump, stainless steel condensing heat exchanger, outdoor vent. Direct electric ignition, 0.95 energy factor, 11,000 BTU/H minimum and 157,000 BTU/H maximum gas rate, 4”W.C. minimum gas supply pressure and 10.5 W.C. maximum gas supply pressor, 0.26 GPM minimum flow rate, 0.40 GPM minimum activation flow rate, and 8.4 GPM maximum flow rate. 3/4”npt gas inlet, 3/4” npt cold water inlet, and 3/4”npt hot water outlet connections. Water flow sensor, electric water control and by-pass control, temperature set at 120°F. Built-in recirculation program, pump timer: Included isolation & pressure relief valves. Provide hot & cold drain vale and thermal expansion tank. Provide 5 year parts warranty. 157000 BTU, 140.0º outlet temp. 4.3 GPM at 70ºF rise.

Water Heater	Rheem RTGH-84DVLN-2
Expansion tank	Amtrol “Therm-X-Trol”

2.12 Thermostatic Mixing Valves:

A. General:

B. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item.

C. Thermostatic Mixing Valve Schedule:

MV-1 WATER MIXING VALVE (THERMOSTATIC MIXING):

Under sink mixing valve with soldered connection, bronze body, limits hot water between 80ºF & 120ºF, double throttling, integral inlet filter washers & check valves, tamper resistant locking cap. Meets ASSE 1070 standards.

Exposed Mixing Valve	Watts MMV-US-M1

2.13 Miscellaneous Fixtures:

A. General:

B. Acceptable Manufacturers: Provide products of one of the manufacturer listed or equal.

UB-1 ICE MAKER HOOK-UP (REFRIGERATOR SPACE):

Recessed metal wall box constructed and suitable for fire rated partitions, complete with factory installed shank valve with 1/4" O.D. copper outlet tested @ 100 P.S.I. Provide approximately 5'-0" of 1/4" O.D. soft copper tubing with compression fitting in tight coil. Anchor box to wall structure. Verify location and mounting height with Architectural drawings or mount to manufacturers recommendations.

Wall box	Guy Gray BIM 875

UB-2 RECESSED UTILITY BOX (CLOTHES WASHER SPACE):

Factory fabricated 16 gauge steel with epoxy finish washing machine wall box with hot and cold water supply and 2" drain. Verify mounting height with Architectural Elevations. Make final connections this contract.

Wall box	Guy Gray B200

DT-1 TROUGH DRAIN:

12”H x 18”W x 3’L, are made of 3/8” ABS plastic, shall be sloped between 1/8” &1/4” per foot, washer can drain into side or top, and the outlet drain can be located at either end or on bottom. Removable lint filter screen made of 1/8” PVC with 3/8” holes on ¾” spacing, & are designed with a safety overflow. End of drain pipe should be 1” below top of trench.

Trough Drain	High Mark Drain Trough

TD-1 TRENCH DRAIN:

12” wide with 6-5/8” wide throat pre channel with 0.7% slope, each channel is 4’-0” in length, molded of gray structural foam polyethylene HDPE with UV inhibitors with interlocking ends, and a 4” outlet with trap. Ductile iron class D rated (H20) grate comes in 6” x 24” sections with screws. Shall have 0.7% slope with an ending slope of 7.69”, and shall be a flo-thru model with a 4” bottom outlet. Length of 40’.

Trench Drain	NDS Dura Slope
Trench Grate	NDS DS-232

CP-1 CIRCULATOR PUMP (INLINE TYPE):

Self-adjusting high-efficiency circulator made of engineered polymer impeller, stainless steel shaft, metal impregnated carbon, and cast iron cataphoresis coated casting. A 1/4 HP ECM permanent magnet motor and electrical characteristics are 115v/1 phase, 47-63 hz.., 2.6' head at 1 gpm with 3/4" to 1-1/2" connections, maximum operating pressure of 145 PSI, five operating modes(automatic, proportional pressure, constant pressure, programmed speed, and night setback) UL standard 778 and CSA standard 22.2 no. 108 . Digital timer with circulator programming. Temperature aquastst, maintains water temperature between 95ºF and 115ºF. Circuit Setter calibrated balance valve, 1/2" size, leed-free brass, with 1/4" NPT tapped drain port, memory stop feature, set at 1 gpm. Provide Circuit Solver a self-acting thermostatic recirculation valve set at 110ºF.

Circulator	TACO VR3452-FC1A00
Timer	TACO 265-3
Aquastat	TACO 563-2
Circuit setter	Xylem CB-1/2S LF
Recirculation Valve	Circuit Solver CS-1/2-110, CS-1/2-110,

PART 3 EXECUTION

3.01 Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 Install plumbing fixtures of types indicated where shown and at indicated heights. Install in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Install in accordance with ADA and applicable handicap code requirements. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of Florida Building Code-Plumbing pertaining to installation of plumbing fixtures. Furnish templates for cut-outs in countertops. Coordinate exact fixture locations with countertop shop drawings.

3.03 Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement. Mount at heights shown on the drawings. Fixture heights are floor-to-rim distance. Fitting heights are to centerline.

3.04 Install stop valve in water supply to each fixture.

3.05 After fixtures are set, the crack between the fixture and wall shall be caulked with DAP silicone-based caulking, or approved equal.

3.06 Protect installed fixtures from damage during remainder of construction period.

3.07 Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements.

When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.08 Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect/Engineer. Remove cracked or dented units and replace with new units.

3.09 Clean plumbing fixtures, trim, aerators, and strainers of dirt and debris upon completion of installation.

3.10 Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream and specified gpm.

3.11 Adjust or replace washers to prevent leaks at faucets and stops.

END OF SECTION 22 30 00

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 01 00 - MECHANICAL GENERAL

PART 1 GENERAL

1.01 The work covered by this division consists of providing all labor, equipment and materials and performing all operations necessary for the installation of the mechanical work as herein called for and shown on the drawings.

1.02 Related Documents:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. This is a Basic Mechanical Requirements Section. Provisions of this section apply to work of all Division 21, 22, and 23 sections.

C. Review all other contract documents to be aware of conditions affecting work herein.

D. Definitions:

1. Provide: Furnish and install, complete and ready for intended use.

2. Furnish: Supply and deliver to project site, ready for subsequent requirements.

3. Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

1.03 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.04 Verification of Owner's Data: Prior to commencing any work the Contractor shall satisfy himself as to the accuracy of all data as indicated in these plans and specifications and/or as provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Architect/Engineer in order that proper adjustments can be anticipated and ordered. Commencement by the Contractor of any work shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions or inaccuracies of the said data.

1.05 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage.

1.06 Extent of work is indicated by the drawings, schedules, and the requirements of the specifications. Singular references shall not be constructed as requiring only one device if multiple devices are shown on the drawings or are required for proper system operation.

1.07 Field Measurements and Coordination:

A. The intent of the drawings and specifications is to obtain a complete and satisfactory installation. Separate divisional drawings and specifications shall not relieve the Contractor or subcontractors from full compliance of work of his trade indicated on any of the drawings or in any section of the specifications.

B. Verify all field dimensions and locations of equipment to insure close, neat fit with other trades' work. Make use of all contract documents and approved shop drawings to verify exact dimension and locations.

C. Coordinate work in this division with all other trades in proper sequence to insure that the total work is completed within contract time schedule and with a minimum cutting and patching.

D. Locate all apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on mechanical drawings, be guided by architectural details and conditions existing at job and correlate this work with that of others.

E. Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings and passageways. Cut no structural members without written approval.

F. Carefully examine any existing conditions, piping, and premises. Compare drawings with existing conditions. Report any observed discrepancies. It shall be the Contractor's responsibility to properly coordinate the work and to identify problems in a timely manner. Written instructions will be issued to resolve discrepancies.

G. Because of the small scale of the drawings, it is not possible to indicate all offsets and fittings or to locate every accessory. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate piping, ductwork, equipment and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and for coordination with all trades. Contractor shall not order materials or perform work without such verification. No extra compensation will be allowed because field measurements vary from the dimensions on the drawings. If field measurements show that equipment or piping cannot be fitted, the Architect/Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.08 Guarantee:

A. The Contractor shall guarantee labor, materials and equipment for a period of two (2) years from Final Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary

adjustments to and replacement of defective items without expense to the Owner.

B. Owner reserves right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

C. The contractor shall provide routing maintenance for entire system, including all materials and labor required, during the two (2) year warranty period.

1.09 Approval Submittals:

A. When approved, the submittal control log and submittals shall be an addition to the specifications herewith, and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1. Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and Division 1 Specification sections and the following.

2. Submittals shall be properly organized in accordance with the approved submittal control log.

3. Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

4. Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.

5. Submittals shall have been reviewed and approved by the General Contractor (or Prime Contractor). Evidence of this review and approval shall be an "Approved" stamp with a signature and date on the cover sheet.

6. Submittals that include a series of fixtures or devices (such as plumbing fixtures or valves) shall be organized by the fixture number or valve type and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether or not those items are used on other fixtures.

7. The electrical design shown on the drawings supports the mechanical equipment basis of design specifications at the time of design. If mechanical equipment is submitted with different electrical requirements, it is the responsibility of the mechanical contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the mechanical submittal with a written statement that this change will be provided at no additional cost. Mechanical submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

B. If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.

C. Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.

D. Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations and details to scale (not smaller than ¼" per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable. Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final “Approved” or “Approved as Noted” copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required by Division 1 and as described herein.. Submit manuals at the Substantial Completion inspection.

PART 2 PRODUCTS

2.01 All materials shall be new or Owner-supplied reused as shown on the drawings, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.02 Equipment and Materials:

A. Shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.

B. Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated or painted.

C. The label of the approving agency, such as UL, IBR, ASME, ARI, AMCA, by which a standard has been established for the particular item shall be in full view.

D. The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

E. A service organization with personnel and spare parts shall be available within two hours for each type of equipment furnished.

F. Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

G. Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material and type of construction desired. Manufacturer's products shown on the drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products, or the particular products of named manufacturers, meet the detailed specifications and that size and arrangement of equipment are suitable for installation.

H. Model Numbers: Catalog numbers and model numbers indicated in the drawings and specifications are used as a guide in the selection of the equipment and are only listed for the contractor's convenience. The contractor shall determine the actual model numbers for ordering materials in accordance with the written description of each item and with the intent of the drawings and specifications.

2.03 Requests for Substitution:

A. Where a particular system, product or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product or material specified.

B. Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.

1. Required product cannot be supplied in time for compliance with Contract time requirements.

2. Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by Contractor.

3. Substantial cost advantage is offered Owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation and other necessary services and similar considerations.

C. All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:

Principal of operation.
Materials of construction or finishes.
Thickness of gauge of materials.
Weight of item.
Deleted features or items.
Added features or items.
Changes in other work caused by the substitution.
Performance curves.

If the approved substitution contains differences or omissions not specifically called to the attention of the Architect/Engineer, the Owner reserves the right to require equal or similar features to be added to the substituted products (or to have the substituted products replaced) at the Contractor's expense.

PART 3 EXECUTION

3.01 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any materials installed which do not present an orderly and reasonably neat and/or workmanlike appearance, or do not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.02 Coordination:

A. The Contractor shall be responsible for full coordination of the mechanical systems with shop drawings of the building construction so the proper openings and sleeves or supports are provided for piping, ductwork, or other equipment passing through slabs or walls.

B. Any additional steel supports required for the installation of any mechanical equipment, piping, or ductwork shall be furnished and installed under the section of the specifications requiring the additional supports.

C. It shall be the Contractor's responsibility to see that all equipment such as valves, dampers, filters and such other apparatus or equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the drawings.

D. All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

E. The contractor shall protect equipment, material, and fixtures at all times. He shall replace all equipment, material, and fixtures which are damaged as a result of inadequate protection.

F. Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.

G. Start of work will be construed as acceptance of suitability of work of others.

3.03 Interruption of Service: Before any equipment is shut down for disconnecting or tie-ins, arrangements shall be made with the Architect/Engineer and this work shall be done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.04 Phasing: Provide all required temporary valves, piping, ductwork, equipment and devices as required. Maintain temporary services to areas as required. Remove all temporary material and equipment on completion of work unless Engineer concurs that such material and equipment would be beneficial to the Owner on a permanent basis.

3.05 Cutting and Patching: Notify General Contractor to do all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.

3.06 Equipment Setting: Bolt equipment directly to concrete pads or vibration isolators as required, using hot-dipped galvanized anchor bolts, nuts and washers. Level equipment.

3.07 Painting: Touch-up factory finishes on equipment located inside and outside shall be done under Division 23. Obtain matched color coatings from the manufacturer and apply as directed. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.08 Clean-up: Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, contractor is to carefully clean up and leave premises and all portions of building free from debris and in a clean and safe condition.

3.09 Start-up and Operational Test: Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.10 Climate Control: Operate heating and cooling systems as required after initial startup to maintain temperature and humidity conditions to avoid freeze damage and warping or sagging of ceilings and carpet.

3.11 Record Drawings:

A. During the progress of the work the Contractor shall record on their field set of drawings the exact location, as installed, of all piping, ductwork, equipment, and other systems which are not installed exactly as shown on the contract drawings.

B. Upon completion of the work, record drawings shall be prepared as described in the General Conditions, Supplementary Conditions, and Division 1 sections.

3.12 Acceptance:

A. Punch List: Submit written confirmation that all punch lists have been checked and the required work completed.

B. Instructions: At completion of the work, provide a competent and experienced person who is thoroughly familiar with project, for one day to instruct permanent operating personnel in operation of equipment and control systems. This is in addition to any specific equipment operation and maintenance training.

C. Operation and Maintenance Manuals: Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Manuals shall contain:

Detailed operating instructions and instructions for making minor adjustments.
Complete wiring and control diagrams.
Routine maintenance operations.
Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.
Copies of approved submittals.
Copies of all manufacturer's warranties.
Copies of test reports and verification submittals.

D. Record Drawings: Submit record drawings.

E. Test and Balance Report: Submit four certified copies. The Report shall be submitted for review prior to the Substantial Completion Inspection unless otherwise required by Division 1.

F. Acceptance will be made on the basis of tests and inspections of job. A representative of firm that performed test and balance work shall be in attendance to assist. Contractor shall furnish necessary mechanics to operate system, make any necessary adjustments and assist with final inspection.

G. Control Diagrams: Frame under glass and mount on equipment room wall.

END OF SECTION 23 01 00

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 05 20 - PIPES AND PIPE FITTINGS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-21, 22, and 23 section making reference to pipes and pipe fittings specified herein.

1.03 Extent of pipes and pipe fittings required by this section is indicated on drawings and/or specified in other Division-21, 22, and 23 sections.

1.04 Codes and Standards:

A. Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

B. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.

1.05 Test Report and Verification Submittals:

A. Submit welding certification for all welding installers.

B. Submit brazing certification for all brazing installers.

PART 2 PRODUCTS

2.01 Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

2.02 Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.03 Piping Materials/Products:

A. Soldering Materials:

1. Tin-Antimony (95-5) Solder: ASTM B-32, Grade 95TA.

2. Silver-Phosphorus Solder: ASTM B-32, Grade 96TS.

B. Pipe Thread Tape: Teflon tape.

C. Protective Coating: Koppers Bitumastic No. 505 or equal.

D. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast iron flanges; raised-face for steel flanges, unless otherwise noted.

E. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials. Materials shall be determined by installer to comply with installation requirements.

F. Brazing Materials: Silver content of not less than 15%. Materials shall be determined by installer to comply with installation requirements.

2.04 Copper Tube and Fittings:

A. Copper Tube:

1. Copper Tube: ASTM B88; Type K or L as indicated for each service; hard-drawn temper unless specifically noted as annealed.

2. ACR Copper Tube: ASTM B280.

3. DWV Copper Tube: ASTM B306.

B. Fittings:

1. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.

2. Copper Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.

3. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.

4. Cast-Copper Flared Tube Fittings: ANSI B16.26.

2.05 Steel Pipes and Pipe Fittings

A. Pipes:

1. Black Steel Pipe: ASTM A-53 or A-120, seamless.

2. Galvanized Steel Pipe: ASTM A-53 or A-120, seamless.

B. Pipe Fittings:

2. Threaded Cast Iron: ANSI B16.4.

3. Threaded Malleable Iron: ANSI B16.3; plain or galvanized as indicated.

4. Malleable Iron Threaded Unions: ANSI B16.39; selected by installer for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.

5. Threaded Pipe Plugs: ANSI B16.14.

6. Flanged Cast Iron: ANSI B16.1, including bolting.

7. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing.

8. Wrought-Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns, rated to match connected pipe.

9. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than schedule 80 pipe where length remaining unthreaded is less than 1 ½ inches, and where pipe size is less than 1 ½ inches, and do not thread nipples full length (no close-nipples).

2.06 Plastic Pipes and Fittings:

A. Pipes:

1. PVC DWV Pipe: ASTM D-2665, Schedule 40.

2. PVC Sewer Pipe: ASTM D-3034.

B. Fittings:

1. PVC Solvent Cement: ASTM D-2564.

2. PVC DWV Socket: ASTM D-2665.

3. PVC Sewer Socket: ASTM D-3034.

PART 3 EXECUTION

3.01 Installation

A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leak proof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings, not bushings. Align piping accurately at connections, within 1/16" misalignment tolerance.

B. Comply with ANSI B31 Code for Pressure Piping.

C. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing

building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of building; limit clearance to ½" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation.

D. Concealed Piping: Unless specifically noted as “Exposed” on the drawings, conceal piping from view in finished and occupied spaces, by locating in column enclosures, chases, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

E. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical, communications, or data equipment spaces and enclosures unless shown. Install drip pan under piping that must run through electrical spaces.

1. Cut pipe from measurements taken at the site, not from drawings. Keep pipes free of contact with building construction and installed work.

3.02 Piping System Joints: Provide joints of the type indicated in each piping system.

A. Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply non-acid type solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

B. Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed. Paint exposed threads to retard rusting.

C. Flanged Joints: Match flanges within piping system, and at connection with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets. Bolts shall project 1/8" to 3/8" beyond nut face when tight.

D. Weld pipe joints in accordance with recognized industry practice and as follows. Be guided by ANSI B.31.

1. Weld pipe joints only when ambient temperature is above 0°F.

2. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.

3. Use pipe clamps or tack-weld joints; 4 welds for pipe sizes to 10". All welds shall be open-butt.

4. Build up welds with root pass, followed by filler pass and then a cover pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.

5. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.

6. At Installer's option, install forged branch-connection fittings wherever branch pipe is less than 3" and at least two pipe sizes smaller than main pipe indicated; or install regular "T" fitting. Weld-O-Let or equal.

E. Plastic Pipe Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards.

1. Solvent-cemented joints shall be made in accordance with ASTM D-2235 and ASTM F-402.

2. PVC sewer pipe bell/gasket joints shall be installed in accordance with ASTM D-2321.

F. Braze copper tube-and-fitting joints where indicated, in accordance with ANSI B.31.

3.03 Piping Installation

A. Install piping to allow for expansion and contraction.

B. Isolate all copper tubing from steel and concrete by wrapping the pipe at the contact point, and for one inch on each side, with a continuous plastic sleeve. Isolate all copper tubing installed in block walls with a continuous plastic sleeve.

C. Underground Piping:

1. Provide plastic tape markers over all underground piping. Provide copper wire over all underground plastic piping. Locate markers 18" above piping.

2. Coat the following underground (uninsulated) pipes with a heavy coat of bitumastic or provide an 8 mil polyvinyl sleeve: black steel pipe, galvanized steel pipe, copper tubing.

END OF SECTION 23 05 20

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 05 21 - PIPING SPECIALTIES

PART 1 GENERAL

1.01 Drawings and general provisions of contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-21, 22 and 23 section making reference to or requiring piping specialties specified herein.

PART 2 PRODUCTS

2.01 General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

2.02 Escutcheons:

A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons: Provide cast brass or sheet brass escutcheons, solid or split hinged.

2.03 Dielectric Unions: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action and stop corrosion. .

2.04 Fire Barrier Penetration Seals:

A. Provide seals for any opening through fire-rated walls, floors, or ceilings used as passage for mechanical components such as piping or ductwork in accordance with the requirements of Division 7.

2.05 Fabricated Piping Specialties:

A. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over ¼" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.

B. Pipe Sleeves: Provide pipe sleeves of one of the following:

1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gages: 3" and smaller, 20 gage; 4" to 6" 16 gage; over 6", 14 gage.

2. Steel-Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

3. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe; remove burrs.

C. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:

1. Caulking and Sealant: Provide foam or caulking and sealant compatible with piping materials used.

PART 3 EXECUTION

3.01 Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

3.02 Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

3.03 Fire Barrier Penetration Seals: Provide pipe sleeve as required. Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions. Refer to Division 7.

3.04 Drip Pans: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

3.05 Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than 2 pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves ¼" above level floor finish, and ¾" above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

A. Install sleeves in fire-rated assemblies in accordance with the listing of the assembly and the fire barrier sealant.

B. Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings. Fill annular space with caulking or fire barrier sealant as required.

C. Install steel-pipe sleeves at floor penetrations. Fill annular space with caulking or fire barrier sealant as required.

D. Install iron-pipe sleeves at all foundation wall penetrations and at exterior penetrations; both above and below grade. Fill annular space with caulking or mechanical sleeve seals.

END OF SECTION 23 05 21

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 05 23 - VALVES

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

1.02 This section is a Division-23 Basic Materials and Methods section, and is part of each Division-21, 22, and 23 section making reference to or requiring valves specified herein.

1.03 Extent of valves required by this section is indicated on drawings and/or specified in other Division-21, 22, and 23 sections.

1.04 Quality Assurance:

A. Valve Dimensions: For face-to-face and end-to-end dimensions of flanged or welding-end valve bodies, comply with ANSI B16.10.

B. Valve Types: Provide valves of same type by same manufacturer.

C. Valve Listing: For valves on fire protection piping, provide UL listing.

1.05 Approval Submittals: When required by other Division-23 sections, submit product data, catalog cuts, specifications, and dimensioned drawings for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valves with Division-23 section using the valves, not as a separate submittal.

A. Gate Valves. Type GA.

B. Check Valves. Type CK.

C. Ball Valves. Type BA.

1.06 O&M Data Submittals: Submit a copy of approval submittals. Submit installation instructions, maintenance data and spare parts lists for each type of valve. Include this data in the O&M Manual.

PART 2 PRODUCTS

2.01 General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with specifications and installation requirements. Provide sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections.

2.02 Acceptable Manufacturers: Subject to compliance with requirements, provide valves of one of the producers listed for each valve type. The model numbers are listed for contractor's convenience only. In the case of a model number discrepancy, the written description shall govern.

2.03 Gate Valves:

A. Packing: Select valves designed for repacking under pressure when fully opened, equipped with non-asbestos packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.

B. Comply with the following standards:

Cast Iron Valves: MSS SP-70. Cast Iron Gate Valves, Flanged and Threaded Ends.
Bronze Valves: MSS SP-80. Bronze Gate, Globe, Angle and Check Valves.
Steel Valves: ANSI B16.34. Steel Standard Class Valve Ratings.

C. Types of gate (GA) valves:

1. Threaded Ends 2" and Smaller (GA1): Class 125, bronze body, screwed bonnet, rising stem, solid wedge. Stockham B-100. Nibco T-111. Crane 428. Milwaukee 148.

2. Soldered Ends 2" and Smaller (GA2): Class 125, bronze body, screwed bonnet, non-rising stem, solid wedge. Stockham B-108 or B-109. Nibco S-111. Crane 1334. Milwaukee 149.

3. Flanged Ends 2½" and Larger (GA3): Class 125, iron body, bronze mounted, bolted bonnet, rising stem, OS&Y, solid wedge. Stockham G-623. Nibco F617-0. Crane 465½. Milwaukee F2885.

4. Threaded Ends 2" and Smaller (GA4): Class 150, bronze body, screwed bonnet, rising stem, solid wedge. Stockham B-122. Nibco T-131. Crane 431. Milwaukee 1150.

5. Soldered Ends 2" and Smaller (GA5): Class 150, bronze body, screwed bonnet, rising stem, solid wedge. Stockham B-124. Nibco S-134. Milwaukee 1169.

6. Threaded Ends 2" and Smaller (GA6): 175 WWP, bronze body, screwed bonnet, rising stem, OS&Y, solid wedge, UL-listed. Stockham B-133. Nibco T-104-0.

7. Flanged Ends 2½" and Larger (GA7): 175 WWP, iron body, bolted bonnet, rising stem, OS&Y, solid wedge, UL listed. Stockham G-634. Nibco F-607-0TS

8. Threaded Ends 2" and Smaller (GA8): Class 200, bronze body, union bonnet, rising stem, solid wedge, renewable seat. Stockham B-132. Nibco T-154-SS. Milwaukee 1174.

9. Flanged Ends 2½" and Larger (GA9): Class 250, iron body bronze

mounted, bolted bonnet, rising stem, OS&Y, solid wedge. Stockham F-667. Nibco F-667-0. Crane 7½E. Milwaukee F-2894.

10. Threaded Ends 2" and Smaller (GA10): Class 300, bronze body, union bonnet, rising stem, solid wedge, renewable seat. Stockham B-145. Nibco T-174-SS. Crane 634E. Milwaukee 1184.

11. Flanged Ends 2½" and Larger (GA11): Class 300, cast steel body, bolted bonnet, rising stem, solid wedge, seal-welded seat rings. Provide trim to match use. Stockham 30-0F. Crane 33.

12. Flanged Ends 2½" and Larger (GA12): 300 WWP, iron body, bolted bonnet, bronze mounted, rising stem, OS&Y, solid wedge, UL-listed. Stockham F-670. Nibco F-697-0.

2.04 Ball Valves:

A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.

B. Construction: Ball valves shall be rated for 150 psi saturated steam and 600 psi non-shock cold water. Pressure containing parts shall be constructed of ASTM B-584 alloy 844, or ASTM B-124 alloy 377. Valves shall be furnished with blow-out proof bottom loaded stem constructed of ASTM B-371 alloy 694 or other approved low zinc material. Provide TFE packing, TFE thrust washer, chrome-plated ball and reinforced teflon seats. Valves 1" and smaller shall be full port design. Valves 1¼" and larger shall be conventional port design. Stem extensions shall be furnished for use in insulated piping where insulation exceeds ½" thickness.

C. Comply with the following standards:

MSS SP-72. Ball Valves with Flanged or Butt Welding Ends for General Service.
MSS SP-110. Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

D. Types of ball (BA) valves:

1. Threaded Ends 2" and Smaller (BA1): Bronze two-piece full port body with adjustable stem packing. Nibco T-585-70. Stockham S216-BR-R-T. Milwaukee BA125. Apollo 77-100.

2. Soldered Ends 2" and Smaller (BA2): Bronze three-piece full port body with adjustable stem packing. Nibco S-595-Y-66. Milwaukee BA350. Apollo 82-200.

3. Threaded Ends 1" and Smaller (BA3): Bronze two-piece full port body, UL listed (UL 842) for use with flammable liquids and LP gas. Nibco T-585-70-UL.

4. Threaded Ends 2" and Smaller (BA4): 175 WWP, bronze two-piece body, UL listed for fire protection service. Nibco KT-585-70-UL and KT-580-70-UL.

5. Threaded Ends 2" and Smaller (BA5): 400 WWP, bronze two-piece body, for fire protection service. Nibco KT-580.

6. Threaded Ends 2½" and Smaller (BA6): 300 WWP, bronze three-piece body, gear operator with handwheel, indicator flag, accepts tamper switch, for fire protection, UL listed. Nibco T-505-4 and G-505-4.

7. Flanged Ends 2½" and Larger (BA7): Class 150, carbon steel full bore two-piece body with adjustable stem packing. Nibco F515-CS series. Apollo 88-240.

2.05 Valve Features:

A. General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1

B. Valve features specified or required shall comply with the following:

1. Bypass: Comply with MSS SP-45, and except as otherwise indicated, provide manufacturer's standard bypass piping and valving. Provide for gate valves 8" and larger.

2. Drain: Comply with MSS SP-45, and provide threaded pipe plugs complying with applicable Division-23 pipe or tube section. Provide for gate valves 8" and larger.

3. Flanged: Provide valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

4. Threaded: Provide valve ends complying with ANSI B2.1.

5. Solder-Joint: Provide valve ends complying with ANSI B16.18.

6. Trim: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry unless otherwise specified.

7. Non-Metallic Disc: Provide non-metallic material selected for service indicated in accordance with manufacturer's published literature.

8. Renewable Seat: Design seat of valve with removable disc, and assemble valve so disc can be replaced when worn.

9. Extended Stem: Increase stem length by 2" minimum, to accommodate insulation applied over valve.

10. Mechanical Actuator: Provide factory-fabricated gears, gear enclosure, external chain attachment and chain designed to provide mechanical advantage in operating valve for all valves 4" and larger that are mounted more than 7'-0" above the floor, or are otherwise difficult to operate regardless of height.

PART 3 EXECUTION

3.01 Installation:

A. General: Install valves where required for proper operation of piping and equipment, including valves in branch lines to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward below horizontal plane.

B. Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

C. Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator.

D. Mechanical Actuators: Install mechanical actuators as recommended by valve manufacturer.

3.02 Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:

A Tube Size 2" and Smaller: Threaded valves.

B Pipe Size 2" and Smaller: Threaded valves.

C Pipe Size 2½" and Larger: Flanged valves.

3.03 Non-Metallic Disc: Limit selection and installation of valves with non-metallic disc to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

3.04 Renewable Seats: Select and install valves with renewable seats, except where otherwise indicated.

END OF SECTION 23 05 23

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 05 29 - SUPPORTS, ANCHORS, AND SEALS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Materials and Methods section, and is a part of each Division-21, 22, and 23 section making reference to or requiring supports, anchors, and seals specified herein.

1.03 Extent of supports, anchors, and seals required by this section is indicated on drawings and/or specified in other Division-21, 22, and 23 sections.

1.04 Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports, anchors, and seals.

1.05 MSS Standard Compliance:

A. Provide pipe hangers and supports of which materials, design, and manufacture comply with ANSI/MSS SP-58.

B. Select and apply pipe hangers and supports, complying with MSS SP-69.

C. Fabricate and install pipe hangers and supports, complying with MSS SP-89.

D. Terminology used in this section is defined in MSS SP-90.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers: Subject to compliance with requirements, provide supports and hangers by Grinnel, Michigan Hanger Company, B-Line Systems, or approved equal.

2.02 Horizontal-Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

A. Adjustable Steel Clevises: MSS Type 1.

B. Steel Double Bolt Pipe Clamps: MSS Type 3.

C. Adjustable Steel Band Hangers: MSS Type 7.

D. Steel Pipe Clamps: MSS Type 4.

E. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

F. Single Pipe Rolls: MSS Type 41.

G. Adjustable Roller Hanger: MSS Type 43.

H. Pipe Roll Stands: MSS Type 44 or Type 47.

2.03 Vertical-Piping Clamps: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

A. Two-Bolt Riser Clamps: MSS Type 8.

B. Four-Bolt Riser Clamps: MSS Type 42.

2.04 Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

A. Steel Turnbuckles: MSS Type 13.

B. Malleable Iron Sockets: MSS Type 16.

2.05 Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.

A. Center Beam Clamps: MSS Type 21.

B. C-Clamps: MSS Type 23.

C. Malleable Beam Clamps: MSS Type 30.

D. Side Beam Brackets: MSS Type 34.

E. Concrete Inserts: MSS Type 18.

2.06 Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

A. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

B. Protection Saddles: MSS Type 39; use with rollers, fill interior voids with segments of insulation matching adjoining insulation.

2.07 Miscellaneous Materials:

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A 36.

C. Cement Grout: Portland cement (ANSI/ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

D. Heavy-Duty Steel Trapezes: Fabricate from steel shapes or continuous channel struts selected for loads required; weld steel in accordance with AWS standards.

PART 3 EXECUTION

3.01 Preparation

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, and installers of other work requiring coordination with work of this section for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.02 Installation of Building Attachments:

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

B. In areas of work requiring attachments to existing concrete, use self drilling rod inserts, Phillips Drill Co., "Red-Head" or equal.

3.03 Installation of Hangers and Supports:

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69 or as listed herein, whichever is most limiting. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

1. Horizontal steel pipe and copper tube 1-1/4" diameter and smaller: support on 6 foot centers.

2. Horizontal steel pipe and copper tube 1-1/2" diameter and larger: support on 10 foot centers.

3. Vertical steel pipe and copper tube: support at each floor.

4. Plastic pipe: support in accordance with manufacturer's recommendations.
5. Fire protection piping: support in accordance with NFPA 13.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

C. Paint all black steel hangers with black enamel. Galvanized steel and copper clad hangers do not require paint.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

E. Provision for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

F. Insulated Piping: Comply with the following installation requirements.

1. Shields: Where low-compressive-strength insulation or vapor barriers are indicated, install coated protective shields.

2. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

G. Support fire protection piping independently of other piping.

3.04 Installation of Anchors:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and elbows. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

D. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

3.05 Equipment Bases:

A. Provide concrete housekeeping bases where indicated for all floor mounted equipment furnished as part of the work of Division 23. Size bases to extend minimum of 4" beyond equipment base in any direction; and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

3.06 Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands. Prime and paint with black enamel.

END OF SECTION 23 05 29

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 05 48 - VIBRATION ISOLATION

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to vibration isolation equipment.

1.03 Extent of vibration isolation required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.04 Approval Submittals: When required by other Division-23 sections, submit product data sheets for each type of vibration isolation equipment including configuration and rating data. Submit with Division-23 section using vibration isolation, not as a separate submittal. Provide calculations showing supported weight, deflection, and isolator size and type for each item of supported equipment. Submit for:

A. Equipment Mountings. Type EM.
B. Hangers. Type HA.

1.05 O&M Data Submittals: Submit a copy of approval submittals for each type of vibration isolation equipment. Include this data in O&M Manual.

PART 2 PRODUCTS

2.01 General: Provide factory-fabricated products recommended by manufacturer for use in service indicated. Provide products of types and deflections indicated; provide proper selection as determined by Installer to comply with specifications and installation requirements. Provide sizes which properly fit with equipment. All metal parts installed outside shall be hot dipped galvanized after fabrication.

2.02 Acceptable Manufacturers: Subject to compliance with requirements, provide vibration isolation equipment of: Mason Industries, Keflex, Consolidated Kinetics, Vibration Mountings & Controls, Wheatley or approved equal. All vibration isolators shall be supplied by a single approved manufacturer.

2.03 Equipment Mountings:

A. Select mountings with the required deflection and fastening means. Provide steel rails or bases as required to compensate for equipment rigidity and overhang.

B. Types of equipment mountings (EM):

1. Spring Mountings (EM1): Spring isolators shall be free-standing and laterally stable without any housing. All mounts shall have leveling bolts.

Spring diameter shall be not less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one. Provide a nominal static deflection of at least 1.0". Basis of Design: Mason Industries SLFH.

2. Spring Mountings with Housings (EM2): Spring isolators shall consist of open, stable steel springs and include vertical travel limit stops to control extension when weight is removed. The housing of the spring unit shall serve as blocking during erection of equipment. Provide a nominal static deflection of at least 1.0". All mountings used outside shall be hot dipped galvanized. Basis of Design: Mason Industries SLR.

3. Spring Mountings with Housings (EM3): Spring isolators shall consist of open, stable steel springs with neoprene inserts to limit movement between upper and lower housing on start and stop. Provide a nominal static deflection of at least 1.0". Mountings shall be specifically designed for critical areas on light-weight floors. Basis of Design: Mason Industries C.

4. Neoprene Mountings (EM4): Double deflection neoprene-in-shear mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered. The top and bottom surfaces shall be neoprene ribbed and bolt holes shall be provided in the base. Basis of design: Mason Industries ND.

5. Pads (EM5): Waffle or ribbed pattern neoprene pads shall be fabricated from 40-50 durometer neoprene. Provide rigid steel plate and mounting angles as required. Basis of design: Mason Industries Super W.

2.04 Hangers:

A. Select hangers with the required deflection. Provide all required hanger rods and fasteners.

B. Types of hangers (HA):

1. Hangers (HA1): Vibration hangers shall contain a steel spring set in a neoprene cup manufactured with a grommet to prevent short-circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower-hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Basis of Design: Mason Industries 30.

2. Hangers (HA2): Vibration hangers shall contain a laterally stable steel spring and 0.3" deflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum

additional travel to solid equal to 50% of the rated deflection. Basis of Design: Mason Industries 30N.

3. Hangers (HA3): Double deflection neoprene-in-sheer or EPDM hangers. Units shall be complete with projected neoprene bushing to prevent steel-to-steel contact between hanger box and hanger rod. Average static deflection shall be not less than 0.4 inches. Basis of Design: Mason Industries HD.

PART 3 EXECUTION

3.01 Install vibration isolation devices for the duty indicated and for ease of inspection, adjustment, and proper operation. Install in accordance with the manufacturer's written instructions and coordinate with shop drawings of supported equipment.

3.02 All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

3.03 Piping, ductwork and conduit shall not be suspended from one another or physically contact one another. Vibrating systems shall be kept free from non-vibrating systems.

3.04 Equipment Mountings:

A. Unless otherwise shown or specified, all floor-mounted equipment shall be set on housekeeping equipment bases. Refer to Division-23 section “Supports, Anchors, and Seals”.

B. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators, and such direct support is approved by the equipment manufacturer. All support frames shall be sufficiently stiff and rigid so as to prevent distortion and misalignment of components installed thereon.

C. Align equipment mountings for a free, plumb installation. Isolators that are binding, offset or fully compressed will not be accepted.

3.05 Hangers:

A Position vibration isolation hangers so that hanger housing may rotate a full 360 degrees without contacting any object.

B Install steel angles, channels, rods and fasteners to level equipment, piping or ductwork and to evenly distribute the supported weight.

3.06 Connections of Ducts: Ducts shall be connected to fan intakes and discharges by means of flexible connectors in accordance with Division-23 section "Ductwork Accessories" so that all vibrating equipment is fully isolated.

END OF SECTION 23 05 48

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-22 and 23 section making reference to or requiring identification devices specified herein.

1.03 Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-22 and 23 sections.

1.04 Refer to Division-26 sections for identification requirements of electrical work; not work of this section. Refer to other Division-23 sections for identification requirements for controls; not work of this section.

1.05 Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 PRODUCTS

2.01 General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.02 Painted Identification Materials

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-¼" high letters for ductwork and not less than ¾" high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel.

2.03 Plastic Pipe Markers

A. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers.

1. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with name as shown or specified.

2. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.04 Valve Tags:

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high, and with 5/32" hole for fastener. Provide 1-½" diameter tags, except as otherwise indicated.

B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high, and with 5/32" hole for fastener. Provide 1-½" square black tags with white lettering, except as otherwise indicated.

2.05 Engraved Plastic-Laminate Signs:

A. General: Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver's standard letter style a minimum of 3/4" tall and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8” for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.06 Stamped Nameplates: Provide equipment manufacturer's standard stamped nameplates for motors, AHUs, pumps, etc.

PART 3 EXECUTION

3.01 Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 Ductwork Identification:

A. General: Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures, and at 50' spacings along exposed runs.

C. Access Doors: Provide stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate and procedural information.

3.03 Piping System Identification:

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Plastic pipe markers.

2. Stenciled markers, black or white for best contrast.

B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces and exterior non-concealed locations.

1. Near each valve and control device.

2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.

4. At access doors, manholes and similar access points which permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.

7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

C. The following piping shall be color-coded where exposed in mechanical and electrical rooms by completely painting the piping with the indicated color. Use standard colors where exposed in finished spaces. Use standard identification methods in concealed areas.

Gas piping - Yellow

3.04 Valve Identification: Provide coded valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. Coordinate code with operating instructions.

3.05 Valve Charts: Provide framed, glass covered valve charts in each mechanical room. Identify coded valve number, valve function, and valve location for each valve.

3.06 Mechanical Equipment Identification: Install engraved plastic laminate sign on a vertical surface on or near each major item of mechanical equipment and each operational device. Label shall indicate type of system and area served. Provide signs for the following general categories of equipment and operational devices:

A. Main control and operating valves, including safety devices.

B. Meters, gauges, thermometers and similar units.

C. Water Heaters, Furnaces, and Heaters.

D. Pumps.

E. Fans.

F. HVAC air handlers and fan coil units.

G. Air conditioning indoor and outdoor units.

3.07 Stamped Nameplates: Equipment manufacturers to provide standard stamped nameplates on all major equipment items such as motors, pumps, AHUs, etc. Where motors are hidden from view (within equipment casing, or otherwise not easily accessible, etc.), the equipment supplier shall furnish a duplicate motor data nameplate to be affixed to the equipment casing in an easily visible location, unless data is already included on the equipment nameplate.]

3.08 Adjusting and Cleaning:

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 23 05 53

SECTION 23 05 56 - ACCESS DOORS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-22 and 23 section making reference to or requiring access panels specified herein.

1.03 Approval Submittals:

A. Product Data: When required by other Division-22 and 23 sections, submit product data for access doors. Submit with Division-23 section using access doors, not as a separate submittal. Include rating data.

1.04 O&M Data Submittals: Submit a copy of approval submittal. Include this data in O&M Manuals.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers: Subject to compliance with requirements, provide access doors by Acudor, Milcor, Jay R. Smith, Zurn, BOICO, Elmdor, or approved equal.

2.02 General: Where floors, walls and ceilings must be penetrated for access to mechanical work, provide types of access doors indicated. Furnish sizes indicated or, where not otherwise indicated, furnish adequate size for intended and necessary access. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.

2.03 Access Door Construction: Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth; 16-gauge frames and 14-gauge flush panel doors; 175° swing with concealed spring hinges; flush screw-driver-operated cam locks; factory-applied rust-inhibitive prime-coat paint finish.

PART 3 EXECUTION

3.01 Access doors shall be installed to operate and service all mechanical equipment including valves, dampers, duct access panels, and other items requiring maintenance that are concealed above or behind finished construction. Access doors shall be installed in walls, chase and floors as necessary, but are not required in accessible suspended ceiling systems. Access doors shall have factory applied protective phosphate coating and baked enamel primer suitable for field painting.

3.02 Access doors shall be installed by the Division installing the substrate construction. However, responsibility for furnishing and determining location of access doors is part

of this Division's work. The style of access door shall be suitable for construction into which installed.

3.03 Access doors shall be sized and located as required to provide proper maintenance and service access in accordance with the manufacturer's recommendations and code authority requirements for all devices and equipment.

END OF SECTION 23 05 56

SECTION 23 05 73 - EXCAVATION & BACKFILL

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 and Division -22 section making reference to or requiring excavation and backfill specified herein.

1.03 Refer to other Division-22 and 23 sections and/or drawings for specific requirements of the particular piping system being installed. Where another Division-22 or 23 section or the drawings conflict with requirements of this section, the other Division-22 or 23 section or the drawings shall take precedence over the general requirements herein.

1.04 OSHA: Contractor employee worker protection for all trenching and excavation operations shall comply with 29 CFR 1926.650 Subpart P and all current OSHA requirements.

1.05 Trench Safety Act: Contractor shall comply with all requirements of Florida Statutes Chapter 553, including the requirement to provide a separate line item to identify the cost to comply on a per lineal foot of trench and per square foot of shoring.

PART 2 PRODUCTS

2.01 Sand: Clean, hard, uncoated grains free from organic matter or other deleterious substances. Sand for backfill shall be of a grade equal to mortar sand.

2.02 Gravel: Clean, well graded hard stone or gravel, free from organic material. Size range to be from No. 4 screen retentions to 1".

2.03 Earth: Fill free of clay, muck, stones, wood, roots or rubbish.

2.04 Identification Tape: Polyethylene 6 inches wide, 0.004 inches thick, continuously printed with "CAUTION" in large letters and type of pipe below.

2.05 Copper Identification Wire: 14-gauge.

PART 3 EXECUTION

3.01 Ditching and Excavation: Shall be performed by hand wherever there is a possibility of encountering obstacles or any existing utility lines of any nature whatsoever. Where clear and unobstructed areas are to be excavated, appropriate machine excavation methods may be employed. Avoid use of machine excavators within the limits of the building lines.

3.02 Bedding: Excavate to bottom grade of pipe to be installed, and shape bed of undisturbed earth to contour of pipe for a width of at least 50% of pipe diameter. If earth conditions necessitate excavation below grade of the pipe, such as due to the presence of clay, muck, or roots, subcut and bring bed up to proper elevation with clean, new sand (as described in paragraph 2.1), deposited in 6" layers and tamped. Notify Architect/Engineer if subcut exceeds 12", or if bed is of an unstable nature. In this case a 6" minimum layer of gravel will be required before sand bedding begins. Submit cost proposal if the earth conditions require subcut in excess of 12" or if gravel is required to achieve proper bedding.

3.03 Placing: Pipe shall be carefully handled into place. Avoid knocking loose soil from the banks of the trench into the pipe bed. Rig heavier sections with nylon slings in lieu of wire rope to avoid crushing or chipping. Pipe which is handled with insulation in place, coated pipe, and jacketed pipe shall have special handling slings as required to prevent damage to the material.

3.04 Backfilling: Deposit clean new sand (as described in paragraph 2.1) to 6" above the pipe and tamp. Then deposit sand or earth carefully in 6" layers, maintaining adequate side support, especially on nonferrous piping materials. Compact fill in 6" layers, using mechanical means, up to the top elevation of the pipe, and in 12" layers to rough or finish grade as required. Fine grade and restore surface to original condition.

3.05 Special: Excavations shall be installed and maintained in satisfactory condition during the progress of the work. Subsurface structures are to be constructed in adequately sized excavations. De-watering equipment shall be installed and properly maintained where required. Shoring shall be employed in the event of unstable soil condition, and in all cases where required by OSHA regulations and necessary to protect materials and personnel from injury.

3.06 Identification: Install identification tape directly above all underground piping, one tape for each pipe where multiple pipes are installed. Depth of tape shall be at least 6 inches below finished grade and 24" above buried pipe. Install copper wire above non-metallic pipes.

3.07 Depth of Cover: Minimum cover for underground piping is two feet unless indicated otherwise.

END OF SECTION 23 05 73

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 05 90 - START-UP REQUIREMENTS FOR HVAC SYSTEMS

PART 1 GENERAL

1.01 Intent: It is the intent of this section to require that the startup requirements and report noted herein be performed prior to starting TAB work on each system. Work can be phased with permission of the Engineer.

1.02 Coordination:

A. The Contractor shall furnish to the TAB Contractor a complete set of plans, specifications, addenda, shop drawings, equipment performance data sheets, change orders, etc. as requested by the TAB Contractor.

B. The Contractor shall participate in a TAB coordination meeting to discuss interface requirements with the TAB Contractor and to establish a schedule for TAB work prior to start of TAB work.

1.03 Test Reports and Verification Submittals:

A. Submit Startup Report as described herein for each system. Attach Factory Startup Report for equipment as required by other Division-23 sections.

PART 2 PRODUCTS: None

PART 3 EXECUTION:

3.01 The TAB work shall not commence until the Engineer has received written notice from the Contractor that HVAC systems are 100% complete and are fully operational. Submit Startup Report as described herein.

3.02 The Contractor shall place all HVAC systems and equipment into complete operation during each working day of TAB work.

3.03 The Contractor shall provide access to HVAC systems and equipment by supplying ladders and/or scaffolding, and opening access panels and equipment room doors.

3.04 The TAB Contractor will provide to the Contractor TAB punch lists of non-complying HVAC work as they are discovered. The Contractor shall replace or repair non-complying work as soon as possible in order not to delay completion of TAB work.

3.05 Airside Systems: The Contractor shall provide the following information to the Engineer to substantiate proper start-up and preliminary adjustments of air handler units, belt driven fans, and duct systems.

A. Verify that air grilles (supply, return, exhaust, transfer, outdoor, etc.) are installed and connected to the duct system.

B. Verify that duct systems are clean of debris.

C. Verify that ducts attached with flexible connectors are aligned within ½" and have a uniform gap between ducts of 1"-1.5". Flexible connectors shall not leak and shall be insulated.

D. Verify that filters are clean and filter spacers are installed.

E. Verify that balancing dampers at grilles and branch ducts are operational and are fully opened.

F. Verify that fan discharges are appropriate for the outlet ductwork with regards to the "system effect" per AMCA Publication 201. Inappropriate fan discharges will not be accepted.

G. Verify proper fan rotation.

H. Verify proper belt drive alignment.

I. Verify fan motor overload elements are correctly sized.

J. Adjust fan sheave until CFM is at or above design CFM. Provide additional sheaves and belts as required. Verify that motor is not overloaded.

K. Verify that HVAC control systems are fully operational.

3.06 Startup Report: The Contractor shall submit the startup information required by this section to the Engineer in a typed report organized as outlined herein. The Startup Report is required to meet the written notice described herein prior to starting TAB work. TAB work will not start until the Startup Report has been submitted and approved.

END OF SECTION 23 05 90

SECTION 23 05 91 - TESTING, CLEANING, AND STERILIZATION OF PIPING SYSTEMS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-21, 22, and 23 section making reference to or requiring the testing and other procedures specified herein.

1.03 Notify the Architect/Engineer when system tests are ready to be witnessed at least 24 hours prior to the test.

1.04 All materials, test equipment, and devices required for cleaning, testing, sterilizing or purging shall be provided by the Contractor.

PART 2 PRESSURE TESTS

2.01 General: Provide temporary equipment for testing, including pump and gauges. Test piping systems before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with indicated medium and pressurize for indicated pressure and time.

2.02 Required test period is four hours.

2.03 No piping, fixtures, or equipment shall be concealed or covered until they have been tested. The contractor shall apply each test and ensure that it is satisfactory for the period specified before calling the Architect/Engineer to observe the test. Test shall be repeated upon request to the satisfaction of those making the inspection.

2.04 Observe each test section for leakage at the end of the test period. Test fails if leakage is observed or if pressure drop exceeds 5% of the test pressure.

2.05 Check of systems during application of test pressures should include visual check for water leakage and soap bubble or similar check for air and nitrogen leakage.

2.06 During heating and cooling cycles, linear expansion shall be checked at all elbows and expansion joints for proper clearance.

2.07 Repair piping systems sections which fail required piping test. Disassemble and re-install using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

2.08 Pressure Test Requirements:

A. Soil, Waste, and Vent Test all piping within the building with a 10 foot head of water. Test piping in sections so that all joints are tested. Provide test tees as required.

B. Gas: Test with air or nitrogen at 150% of normal working pressure, but not less than 25 psig. The test and check for leaks shall be in accordance with NFPA-54.

C. Domestic Water: Perform hydrostatic test on all piping within the building at twice the normal static pressure at service point, but not less than 100 psig. Once tested, flush out piping and leave under pressure of the supply main or 40 psig for the balance of the construction period.

D. Fire Sprinkler System: Perform hydrostatic test at 200 psig

PART 3 CLEANING AND STERILIZATION

3.01 General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water or blowdown with air before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.02 Flush and drain all water systems at least three times. Reverse flush systems from smallest piping to largest piping. Replace startup strainers with operating strainers.

3.03 Blowdown all systems with air or nitrogen (at a rate of flow exceeding design) at least three times or until no residue shows at each outlet. Reverse blowdown systems from smallest piping to largest piping.

3.04 Sterilization of Domestic Water Systems:

A. Prerequisites: All new hot and cold water piping installed (complete), all fixtures connected, system flushed out, and system filled with water.

B. The shut off valve at the point of connection shall be closed, all fixture outlets opened slightly, and a sterilizing solution shall be introduced at a manifold connection installed by the Contractor at the point of connection.

C. The solution shall contain 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine or calcium hypochlorite. The solution shall be allowed to stand in the system for at least eight hours after which the entire system shall be flushed.

D. After final flushing, all aerators shall be removed, cleaned, and reinstalled. After final flush the residual chlorine shall not exceed 0.2 parts per million.

E. The Architect/Engineer shall be notified 24 hours prior to the procedure so that it can be witnessed.

F. Provide sampling and certified report by an independent testing lab. Provide written Health Department approval of disinfection samples.

3.05 Fuel Gas: Purge all fuel gas systems in accordance with NFPA 54.

END OF SECTION 23 05 91

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 05 93 - TESTING AND BALANCING OF MECHANICAL SYSTEMS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section. Division-23 Basic Mechanical Materials Sections apply to work of this section.

1.02 Description of Work:

A. Extent of testing, adjusting, and balancing work (TAB) is indicated by requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, air distribution systems, hydronic distribution systems and associated equipment and apparatus of mechanical work. The work consists of setting speed and volume (flow) adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required.

B. Coordination: Coordinate with the General Contractor and Mechanical Contractor responsible for the HVAC system installation as required to complete the TAB work.

1.03 The intent of this specification is to balance HVAC systems within the tolerances listed, maintaining the pressure relationships indicated, with a minimum of noise.

A. Airflow Tolerances:

1. Air Handling: The supply air, return air and outdoor air quantities shall be balanced within ±5% of design values.

2. Exhaust Fans: The exhaust fan quantities shall be set as required to maintain the design exhaust terminal flows within ±5% of design values. If no exhaust terminals exist, exhaust fan air quantities shall be balanced within ± 10% of design values.

3. Ceiling Diffusers, Supply Registers, Return and Exhaust Inlets: Balance to an air quantity within ±10% of the design values.

B. Temperature Tolerances:

1. Air Handling Temperatures: The controlled temperatures at AHUs shall be verified to be under control within ±1ºF of design values.

2. Room Temperatures: Balance systems and controls within ±2ºF of indicated settings.

C. Pressure Relationships: Where code or design indicates a specific pressure relationship, the pressure relationship shall take precedence over airflow

tolerances. Airflow tolerances may need to be held tighter than allowed tolerances to meet pressure relationships.

1.04 Quality Assurance: The TAB Contractor's main office shall be located within 125 miles of the project site and certified as one of the following:

A. Tester: A firm certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, who is not the Installer of the systems to be tested and is otherwise independent of the project. Comply with NEBB's "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" as applicable to this work.

B. Tester: A firm certified by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project. AABC-certified firms are independent by definition. Comply with AABC's Manual MN-1 "AABC National Standards", as applicable to this work.

C. Industry Standards: Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.

1.05 Job Conditions:

A. Do not proceed with testing, adjusting, and balancing work until HVAC work (including Controls) has been completed and is operable. Ensure that there is no residual work still to be completed.

B. Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

C. Do not proceed until architectural work that would affect balancing (walls, ceiling, windows, doors) have been installed.

D. Testing may proceed system by system, but each HVAC system must be complete as describe herein.

E. The mechanical contractor shall make any changes in pulleys, belts, and dampers, and/or add dampers as required for correct balancing.

1.06 Approval Submittals

A. Submit the name of the proposed test and balance company for the Engineer's approval within thirty (30) days after awarding of contract.

1.07 Test Reports and Verification Submittals:

A. Submit four (4) copies of the dated test and balance report upon completion of TAB work. The report shall include a list of instruments used for the work. The report shall be signed by the supervisor who performed the TAB work.

PART 2 PRODUCTS

2.01 Patching Materials: Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have

been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

2.02 Test Instruments: Utilize test instruments and equipment of the type, precision, and capacity as recommended in the referenced standard. All instruments shall be in good condition and shall have been calibrated within the previous six (6) months (or more recently if required by standard).

PART 3 EXECUTION

3.01 General:

A. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Do not proceed with TAB work until unsatisfactory conditions have been corrected in manner acceptable to Tester.

B. Test, adjust and balance environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, and as modified or detailed herein.

C. Test, adjust and balance systems during summer season for air conditioning systems and during winter season for heating systems, including at least a period of operation at outside conditions within 5ºF wet bulb temperature of maximum summer design condition, and within 10ºF dry bulb temperature of minimum winter design condition. When seasonal operation does not permit measuring final temperatures, then take final temperature readings when seasonal operation does permit. The Contractor shall return for a change of seasons test at no additional cost to the Owner and submit the revised TAB report.

D. Punch List: Prepare a deficiency (punch)list for the Contractor with a copy of the Engineer that lists all items that are incorrectly installed or are functioning improperly. Provide a retest after all items are corrected.

E. Prepare TAB report of test results, including instrumentation calibration reports, in format recommended by applicable standards, modified as required to include all data listed herein.

F. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer.

G. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

H. Include in the TAB report recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

I. Include an extended warranty of ninety (90) days after completion of test and balance work, during which time the Engineer, at his discretion, may request a recheck, or resetting of any component as listed in test report. The TAB company shall provide technicians and instruments and make any tests required by the Engineer during this time period.

3.02 Controls

A. Check all HVAC controls for proper location, calibration and sequence of operation.

B. Check operation of all controllers and controlled devices to verify proper action and direction. Check the operation of all interlocks.

3.03 Air Balancing

A. Leakage tests on ductwork must have been completed before air balancing.

B. Set dampers, volume controls and fan speeds to obtain specified air delivery with minimum noise level. Rebalance as required to accomplish this. Simulate fully loaded filters during test.

C. Set grille deflections as noted on plans. Modify deflections if required to eliminate drafts or objectionable air movement.

D. Record air terminal velocity after completion of balance work.

E. Record final grille and register deflection settings if different from that specified on contract drawings.

F. Record all fan speeds.

3.04 Data Collection:

A. In addition to the data required for any specified performance tests, measure and record the temperatures, pressures, flow rates, and nameplate data for all components listed herein.

B. It is the intent of this section to record data on balanced systems, under normal operating or design conditions.

C. Temperatures:

1. Outside dry and wet bulb temperatures.

2. Dry bulb temperature in each room and at least one wet bulb temperature in each zone.

3. Refrigerant liquid and suction temperatures.

4. Inlet and outlet temperature of each heat exchange device - both fluids.

D. Pressures:

1. Suction and discharge static pressure of each fan.

2. Each refrigerant suction and discharge pressure.

E. Flow rates:

1. Flow rate through each fan.

F. Nameplate Data:

1. Complete nameplate data for all equipment.

2. Motor data to include horsepower, phase, voltage, RPM, full load nameplate current, fuse rating in disconnect switch, number or manufacturer's size designation, and ampere rating of overcurrent and low voltage protection devices in starters.

3.05 All test openings in ductwork shall be resealed in an approved manner.

END OF SECTION 23 05 93

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 07 13 - EXTERIOR INSULATION FOR DUCTWORK

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Approval Submittals:

A. Product Data: Submit producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1. Flexible duct insulation

1.04 O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Knauf, Owens-Corning, Johns Manville, Certainteed.

2.02 Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, coverings, sealers, mastic, and adhesive) with a flame spread rating of 25 or less, and a smoke-developed rating of 50 or less as tested by ANSI/ASTM 84.

2.03 Flexible Fiberglass Insulation: ASTM C553, Type I, Class B-3 (temperature less than 350ºF). Duct wrap shall be 1 pcf density with UL rated aluminum foil vapor barrier (FSK).

2.04 General Purpose Mastic: Benjamin Foster 35-00 Series, Insulcoustic VIAC Mastic, Childers CP-10, or approved equal. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.05 Vapor Barrier Sealant: Benjamin Foster 30-35, Insulcoustic IC-501, 3M EC-1378, Childers CP-30, or approved equal. Provide "Low Odor" type. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.06 Adhesive: Benjamin Foster 85-20, Insulcoustic IC-205, 3M EC-35, Childers CP-82, Childers CP-89, or approved equal. The final selection of this product for the specific

application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.07 Fiber-Glas Mesh: 10x10 Mesh. Foster Mastafab or equal.

PART 3 EXECUTION

3.01 Insulate all supply, return and outdoor air ductwork and the backs of all ceiling supply outlets with 2" thick fiberglass blanket insulation with vapor barrier.

3.02 Installation of Flexible Insulation:

A. Insulate round elbows and fittings with wrap such that thickness is equal to adjoining duct covering. Clean and dry ductwork prior to insulating.

B. Adhere insulation to duct with 50 percent coverage using approved insulation adhesive applied in 6-inch wide swaths with 6-inch spaces between swaths. Additionally secure insulation with perforated pins and Tuff-Bond or by self-sticking pins with a 3/8" self-tapping screw. Space on 12-inch centers and 3 inches from all edges. Ducts up through 24" wide only require one row of pins. Ducts over 24" wide shall have pins spaced as described herein.

C. Lap all joints 2 inches and seal joints with 4-inch wide strips of open mesh glass fabric embedded in two coats of general purpose mastic.

D. Seal all punctures and breaks in aluminum vapor barrier with open mesh glass fabric and vapor barrier sealant.

END OF SECTION 23 07 13

SECTION 23 07 16 - INSULATION FOR HVAC EQUIPMENT AND PIPING

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.03 Approval Submittals:

A. Product Data: Submit producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1. Flexible unicellular piping insulation

1.04 O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Armstrong, Johns Manville, Knauf, Owens Corning, Pittsburgh Corning, U.S. Rubber, or approved equal. All products shall be asbestos-free.

2.02 Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesive) with a flame-spread rating of 25 or less, and a smoke-developed rating of 50 or less, as tested by ANSI/ASTM E84.

2.03 Pipe Insulation Materials:

A. Flexible Unicellular Pipe Insulation: ASTM C534, Type I. (Tubular, suitable for use to 200ºF.)

B. Staples, Bands, Wires, and Cement: As recommended by the insulation manufacturer for applications indicated.

C. Adhesives, Sealers, Protective Finishes: Products recommended by the insulation manufacturer for the application indicated.

D. Jackets: ASTM C921, Type I (vapor barrier) for piping below ambient temperature, Type II (vapor permeable) for piping above ambient temperature. Type I may be used for all piping at Installer's option.

PART 3 EXECUTION

3.01 General:

A. Install thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on insulation and protect it to prevent puncture and other damage. Label all insulation "ASBESTOS FREE".

D. Do not apply insulation to surfaces while they are hot or wet.

E. Do not install insulation until systems have been checked and found free of leaks. Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.

F. Do not install insulation on pipe systems until acceptance tests have been completed except for flexible unicellular insulation. Do not install insulation until the building is "dried-in".

3.02 Flexible Unicellular Pipe Insulation:

A. Insulate the following piping systems:

1. Condensate drains from air conditioning units - ½" thick.

2. Refrigerant piping - ¾" thick.

B. Apply insulation in accordance with the manufacturer's recommendations and instructions. Mitre cut insulation to fit pipe fittings. Use approved cement to seal all joints and ends in the insulation.

C. Insulation outside the building shall be protected by a smooth 0.016" thickness aluminum jacket secured with aluminum bands on 12" centers.

END OF SECTION 23 07 16

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 31 13 - HVAC METAL DUCTWORK

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.03 Extent of HVAC metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.04 Refer to other Division-23 sections for exterior insulation of metal ductwork.

1.05 Refer to other Division-23 sections for ductwork accessories.

1.06 Codes and Standards:

A. SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" 1985 Edition for fabrication and installation of metal ductwork, unless otherwise noted.

B. NFPA 90A Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

C. NFPA 96 Compliance: Comply with NFPA 96 "Standard for Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment".

1.07 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data and installation instructions for the following.

1. Factory-fabricated ductwork
2. Sealants
3. Flexible duct
4. Spin-in fittings
5. Side take-off fittings

B. Shop Drawings: Submit scaled layout drawings of HVAC metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not

reduced.

PART 2 PRODUCTS

2.01 Ductwork Materials:

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Galvanized Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations. Stamp gauge and manufacturer's identification on each sheet. Break sheets so that identification is exposed.

C. Stainless Steel Sheet: Where indicated, provide 18-gauge stainless steel complying with ASTM A 167; Type 304 with No. 4 finish where exposed to view in occupied spaces. Provide No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

2.02 Miscellaneous Ductwork Materials:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Sealant: Provide non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

C. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork. For exposed stainless steel ductwork, provide matching stainless steel support materials.

D. Flexible Ducts: Provide flexible ductwork with an R-value of R-6unless the ductwork is in a ceiling return plenum. The use of flexible ductwork for connection of supply air and return air devices is acceptable only where shown on the drawings.

1. Construction: Provide reinforced metalized polyester jacket that is tear and puncture resistant, air tight inner core with no fiberglass erosion in the air stream and an encapsulated wire helix. Flexible ductwork shall have a recommended operating pressure of 6" w.g. for sizes 4" through 12" diameter and 4" w.g. for sizes 14" through 20" diameter. All diameters shall be suitable for a negative operating pressure of 0.75" w.g. Flexible ductwork shall meet the requirements of UL-181, the Florida Energy Code, SBCC, NFPA 90A and NFPA 90B.

2. Acceptable Manufacturers: Subject to compliance with requirements, provide R-6 flexible ductwork by: Atco 36, Flexmaster 8M-R6 or Thermaflex M-KE R6.

E. Spin-in and Side Take-off Fittings: Provide round branch run-outs as follows.

1. Where duct height does not permit the use of conical spin-in fittings, use low profile side take-off fittings equal to Crown 3300-DS or Flexmaster STOD-BO.

F. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° laterals and 45° elbows for branch takeoff connections. Where 90° branches are indicated, provide conical type tees.

2.03 Fabrication:

A. Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards", except provide sealant at all joints. Supply duct from air conditioning units and all return and exhaust duct shall be minimum 2" pressure class unless otherwise noted.

C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1½ times associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements.

2.04 Factory-Fabricated Low Pressure Ductwork (Maximum 2" W.G.):

A. Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized.

B. Gauge: 28-gauge minimum for round ducts and fittings, 4" through 8" diameter. 26-gauge minimum 9" through 14", 24-gauge minimum 15" through 26".

C. Elbows: One piece construction for 90° and 45° elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

D. Divided Flow Fittings: 90° tees, constructed with saddle tap spot welded and bonded to duct fitting body.

E. Acceptable Manufacturers: Subject to compliance with requirements, provide

factory-fabricated ductwork by Semco Mfg., Inc. or United Sheet Metal Div., United McGill Corp, or approved equal.

2.05 Kitchen Exhaust Ducts: Fabricate kitchen exhaust ducts and supports used for smoke and vapor removal from cooking equipment of 16-gauge minimum galvanized steel where concealed, and of 18-gauge minimum stainless steel where exposed. For duct construction, comply with SMACNA "HVAC Duct Construction Standards", and NFPA 96 "Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment". Continuously weld all seams and joints to be grease tight. Provide high temperature fiber blanket thermal insulation incapsulated in a fiberglass-reinforced aluminized polyester foil, 6 pcf, 1.5” thick. The fiber blanket shall have a continuous use limit of 1000C and a Smoke Developed Index and Flame Spread Index of 0/0. 3M “Fire Barrier Duct Wrap 615” or equal.

PART 3 EXECUTION

3.01 General: Examine areas and conditions under which HVAC metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 Installation Of Metal Ductwork:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

B. Supports: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work. Install self-drilling screw anchors in prestressed concrete or existing work.

C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements. Seal joints in round or oval ductwork with hard cast or shrink bands, and sheet metal screws, or by welding. High velocity rectangular ducts shall have approved joints and be made airtight with sealer or welding.

D. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally. Avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to ½" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. In finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction or above suspended ceilings, unless specifically noted as "Exposed". Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts

and similar finished work.

E. Electrical Equipment Spaces: Do not route ductwork through transformer vaults or other electrical equipment spaces and enclosures.

F. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1½". Fasten to duct and substrate. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate.

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards. Fan discharge outlet ducts shall be installed correctly with regard to "system effect" per AMCA Publication 201.

3.03 Installation of Flexible Ducts:

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 5'-0" extended length. Flexible duct shall only be allowed as detailed on the drawings.

B. Installation: Install in accordance with Section III of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible". Support flexible ducts to eliminate pinching and kinking which would restrict flow.

C. Low Pressure: Peel back insulation and slide the inner core over the spin-in or diffuser neck, seal with duct sealant and install Panduit strap tightly. Slide insulation back over the inner core and install another Panduit strap over the insulation outer jacket. Tape is not acceptable.

D. Seal all exposed edges of fiberglass insulation with glassfab and mastic.

3.04 Installation of Kitchen Exhaust Ducts: Fabricate joints and seams with continuous welds for watertight construction. Provide for thermal expansion of ductwork through 2000° F temperature range. Install without dips or traps which may collect residues, except where traps have continuous or automatic residue removal. Provide access openings at each change in direction, located on the sides of the duct 1½" minimum from bottom. Provide access openings with grease-tight covers of same material as duct. Slope horizontal ducts at 1" per foot.

3.05 Leakage Tests: After each duct system is completed, test for duct leakage in accordance with Sections 3 and 5 of the SMACNA HVAC Air Duct Leakage Test Manual. Test pressure shall be equal to pressure class of duct, less 0.5" static pressure. Repair leaks and repeat tests until total leakage is less than 5% of system design air flow for low pressure systems and less than 1% for systems rated over 3".

3.06 Equipment Connections: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.07 Clean ductwork internally free of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration. Keep ducts closed with poly during construction to prevent contamination by construction dust and debris.

3.08 Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

3.09 System Adjustment: Adjust the system to provide functional operation to the extent possible, and leave ready for Testing and Balancing work. It is not the intent of this section to provide final testing and balancing, but to leave the system operational with a minimum of noise.

END OF SECTION 23 31 13

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

1.04 Refer to other Division-23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.05 Codes and Standards:

A. SMACNA Compliance: Comply with applicable portions of both SMACNA "HVAC Duct Construction Standards, Metal and Flexible" .

B. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems" pertaining to installation of ductwork accessories.

1.06 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions as follows:

1. Low pressure manual dampers
2. Control dampers
3. Counterbalanced relief dampers
4. Duct access doors
5. Flexible connections

B. O&M Data Submittals: Submit manufacturer's maintenance data including parts lists. Include this data, product data, and a copy of approval submittals in O&M manual.

PART 2 PRODUCTS

2.01 Dampers:

A. Low Pressure Manual Dampers: Provide 16 gauge dampers of single-blade type (12" maximum blade width) or multiblade type. Damper blades to be gang-operated from a single shaft with nylon or ball bearings on each end. Provide

indexed locking quadrant. Parallel or opposed blade style is acceptable. Provide 2" standoff on locking quadrant for externally insulated duct.

B. Control Dampers: Extruded aluminum (6063-T5) damper frame shall not be less than 0.080” in thickness. Damper frame shall be 4” deep x 1", with duct mounting flanges on both sides of frame. Damper frame shall have a 2" mounting flange on the rear of the damper when installed as Extended Rear Flange install type. Aluminum frame shall be clear anodized to a minimum thickness of 0.7 mil deep. Frame shall be assembled using stainless steel screws. Welded frames shall not be acceptable. Actuators (motors) are provided by control contractor.

1. Blades shall be maximum 6.4” deep extruded aluminum (6063-T5) air-foil profiles with a minimum wall thickness of 0.06”, clear anodized to a minimum thickness of 0.7 mil deep.

2. Blade seals shall be extruded silicone, secured in an integral slot within the aluminum blade extrusions and shall be mechanically fastened to prevent shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals will not be approved.

3. Hexagonal control shaft shall be $^{7}/_{16}$". It shall have an adjustable length and shall be an integral part of the blade axle. A field-applied control shaft shall not be acceptable. All parts shall be stainless steel.

4. Linkage hardware shall be aluminum and stainless steel, installed in the frame side, out of the airstream, and accessible after installation. Linkage hardware shall be complete with stainless steel cup-point trunnion screws to prevent linkage slippage. Linkage that consists of metal rubbing metal will not be approved.

5. Dampers shall be designed for operation in temperatures ranging from -40°F to 212°F.

6. Dampers shall be AMCA rated for Leakage Class 1A at 1 in w.g. static pressure differential. Standard air leakage data to be certified under the AMCA Certified Ratings Program.

7. Dampers shall be custom made to required size, with blade stops not exceeding 1¼” in height.

8. Dampers shall be opposed blade for modulating dampers or parallel blade action for open/shut dampers.

9. Dampers shall be installed in the following manner: Installed in Duct

10. Installation of dampers must be in accordance with manufacturer’s current installation guidelines, provided with each damper shipment.

11. Field supplied intermediate structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width.

12. Acceptable Manufacturers: Subject to compliance with requirements, provide access doors by TAMCO (T.A. Morrison & Co, Inc), Pottorff, Ruskin, or approved equal.

2.02 Turning Vanes: Provide manufactured or fabricated single wall turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

2.03 Duct Access Doors:

A. General: Provide duct access doors of size indicated, or as required for duty indicated.

B. Construction: Construct of same or greater gauge as ductwork served. Provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

C. Acceptable Manufacturers: Subject to compliance with requirements, provide access doors by Air Balance, Inc., Duro Dyne Corp., Ruskin Mfg. Co., Nailor Industries, or Ventfabrics, Inc.

2.04 Flexible Connections:

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following: Duro Dyne Corp., Flexaust (The) Co., or Ventfabrics, Inc.

PART 3 EXECUTION

3.01 Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 Installation of Ductwork Accessories:

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install balancing dampers at all main ducts adjacent to units in return air, outside air and where indicated.

C. Install control dampers in the outside air duct for each outside air unit and otherwise as shown.

D. Install turning vanes in square or rectangular 90º elbows in supply, return, and exhaust air systems, and elsewhere as indicated.

E. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

F. Install flexible connections in ductwork such that the clear length of the connector is approximately two inches. Provide thrust restraints as required. Flexible material shall not be so slack as to take a definite concave or convex shape during fan operation.

G. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.03 Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leakproof performance.

3.04 Adjusting And Cleaning:

A. Adjusting: Adjust ductwork accessories for proper settings.

B. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing". However, the system shall be left functional with all dampers open or throttled.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 23 33 00

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 34 00 - FANS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Extent of fan work required by this section as indicated on drawings and schedules, and by requirements of this section.

1.04 Coordination:

A. Refer to Division-7 sections for installation of prefabricated roof curbs; not work of this section. Furnishing prefabricated roof curbs is part of this section's work.

B. Refer to Division-23 section "Testing, Adjusting, and Balancing" for balancing of fans.

C. Refer to Division-23 HVAC control systems sections for control work required in conjunction with fans.

D. Refer to Division-26 sections for power supply wiring from power source to power connection on fans. Division-26 work will include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.05 Codes and Standards:

A. AMCA Compliance: Provide fans which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Ratings Seal.

B. UL Compliance: Provide fans which are listed by UL and have UL label affixed.

1.06 Approval Submittals:

A Product Data: Submit manufacturer's technical data for fans, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions. Submit assembly-type drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details. Include statement that resin selection is suitable for chemical resistance to the specific application at 170ºF.

1. Fans
2. Vibration Control

1.02 O&M Data Submittals: Submit maintenance data and parts list for each type of fan, accessory, and control. Include these data, a copy of approved submittals, and wiring diagrams in O&M Manual.

PART 2 PRODUCTS

2.01 General: Except as otherwise indicated, provide standard prefabricated fans of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation. Provide accessories as listed in the schedule on the drawings and as described herein. Motors shall be high efficiency per Division-23 section "Motors".

2.02 Acceptable Manufacturers: Subject to compliance with requirements provide fans manufactured by Acme, Greenheck, Loren Cook, Penn, Twin City Fan and Ventilator, Captive Aire, or approved equal unless otherwise noted herein.

2.03 Centrifugal Ceiling Exhausters:

A Fan Assembly: Provide steel housing, plastic or aluminum grille, backdraft damper, statically and dynamically balanced fan wheel, permanently lubricated motor with internal thermal overloads, vibration isolation and all required mounting hardware and brackets. Provide acoustically treated housing for all fans larger than 60 cfm. Mounting type shall be as indicated on the drawings or on the schedule.

B Connectors: Provide adaptors, connectors, and eave elbows as required to connect fan discharges to outlets.

C Outlets: Provide where shown on the drawings (or required by the installation) wall caps, vent caps, or roof jacks, each with birdscreen, to match fans and surrounding construction.

2.04 In-Line Centrifugal Fans:

A Housing: Provide round aluminum or square weather tight housing constructed of steel and painted inside and out with an epoxy finish. Provide venturi type inlet.

B Fan Wheels: Provide aluminum air foil type, backward curved, statically and dynamically balanced.

C Drive: Provide direct or belt drive as scheduled with pre-lubricated, ball bearing, continuous duty type motors. Provide vibration isolation equipment for the entire drive.

D Isolation and Support: Provide spring type vibration isolators and fan support brackets.

2.05 Cooking Hood Fan Package: Except as otherwise indicated, provide packaged, factory-built, roof-mounted, fan package assemblies of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation. The entire unit shall be accessible from the roof through hinged access doors for steam cleaning all ducts and fans from the roof. The unit shall include the following components.

A. Exhaust Fan: Provide heavy gauge aluminum upblast centrifugal exhaust fan with integral grease drain trough and drain fitting. Provide aluminum fan wheel, statically and dynamically balanced. Motor and drive shall be isolated from the air stream and shall be cooled by clean, outside air only. Provide high efficiency motors per Division-23 section "Motors". Provide fully adjustable belt drive and prelubricated ball bearing motor mounted on vibration isolation equipment. Provide birdscreen and thermal barrier. Provide hinged access. The fan shall be AMCA approved and UL-listed for grease removal.

B. Supply Fan: Provide in-line, centrifugal, horizontal supply fan with painted, weatherproof finish. Provide aluminum fan wheel statically and dynamically balanced. Motor and drive shall be mounted on vibration isolation equipment. Provide high efficiency motors per Division-23 section "Motors". Provide fully adjustable belt drive and prelubricated ball bearing motor. Provide 18-gauge painted galvanized steel housing and angle iron support legs. Provide service access to all components.

C. Intake: Provide supply fan intake with birdscreen and 1-inch washable aluminum filters. Maximum face velocity shall be 500 fpm. Provide motorized backdraft damper that opens and closes with supply fan operation. Intake shall be at least 10’ from exhaust fan.

D. Curb: Furnish 12" high, roofed-over type, prefabricated, aluminum curb with integral pressure treated wood nailer and 1-inch thick rigid insulation. Provide curb extensions and sections as required to meet NFPA requirements for exhaust discharge height and supply-exhaust fan separation.

E. Controls: Provide prewired control center complete with: remote control station at hood, master fused disconnect switch, magnetic motor starters with thermal overloads and manual reset, fused 24 volt control transformer, relays, and wiring. The system shall be UL-listed and require single point connection for fan power. The system shall provide fully automatic operation.

2.06 Propeller Wall Fans:

F. Housing: Provide heavy duty all-welded steel housing and supports with epoxy finish. Panels shall have streamlined orifices.

G. Fan: Provide air foil type steel or aluminum propellers.

H. Drive: Provide direct or belt drive as scheduled with pre-lubricated, ball bearing, continuous duty type motors. Provide vibration isolation equipment for the entire drive.

I. Wall Collar or Housing: Provide galvanized steel fan wall collar or housing as required.

J. Fan Guard: Provide OSHA approved galvanized steel mesh fan guard.

2.07 Vibration Isolation: Mount fans on vibration isolators in accordance with the requirements of Division-23 section "Vibration Isolation" and the following list.

A Equipment Mountings: Type EM4.

B Hangers: Type HA3.

PART 3 EXECUTION

3.01 General: Except as otherwise indicated or specified, install fans in accordance with manufacturer's installation instructions and recognized industry practices to insure that fans serve their intended function.

3.02 Coordinate fan work with work of roofing, walls, and ceilings as necessary for proper interfacing. Framing of openings, caulking, and curb installation is not work of this section.

3.03 Ductwork: Refer to Division-23 section "Ductwork". Connect ducts to fans in accordance with manufacturer's installation instructions. Provide flexible connections in ductwork at fans.

3.04 Install fans on vibration isolation equipment as required. Set level and plumb.

3.05 Roof Curbs: Furnish roof curbs to roofing Installer for Installation.

3.06 Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.07 Remove shipping bolts and temporary supports within fans. Adjust dampers for free operation.

3.08 Testing: After installation of fans has been completed, test each fan to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.09 Cleaning: Clean factory-finished surfaces. Remove all tar and soil. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 23 34 00

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 34 43 - HIGH VOLUME LOW SPEED FANS

PART 1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of fan work required by this section as indicated on drawings and schedules, and by requirements of this section.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used shall include:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Power and mounting requirements.

C. Application Drawings: Submit plan, section, elevation and isometric views as necessary to convey the information required to detail all installation conditions for each unit specified.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: The manufacturer shall be the sole source for design, engineering, manufacturing and warranty claims handling.

B. Installer Qualifications: Any and all work outside the scope of the installation guide shall be outsourced. Factory trained installers are recommended and available upon request.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimal results. Do not install products in environmental conditions outside the manufacturer's absolute limits.

1.7 COORDINATION

A. The fan shall be capable of receiving a stop command from the fire panel, an ASD (Aspirating Smoke Detection) device, or any number of smoke, flame or heat detectors.

B. The fans shall be as follows:
   1. The fan shall meet the air velocity requirements of FM Global's 2.0 data sheet for ESFR sprinklers.

2. If required by the local fire prevention authority or desired by the purchaser, the fan shall be wired into the building's fire suppression system so that the fan will automatically shut off within a maximum of 90 seconds after sprinklers are activated. To facilitate this automatic shut-down, the fan shall include a Variable Frequency Drive (VFD) within the control panel. The low voltage wire and relay needed to accomplish this must be supplied by the Fire Alarm installer.
3. Upon fire detection as described above, the fans shall coast to stop as required by NFPA guidelines.

1.8 WARRANTY

A. The manufacturer shall replace any products or components defective in material or workmanship for the customer free of charge (including transportation charges within the USA, FOB Lexington, KY), pursuant to the complete terms and conditions of the Big Ass Fans Warranty in accordance to the following schedule:

Mechanical	7 years
Electrical	3 years
Labor	1 year

B. The warranty shall not require the submission of a post installation form or photographs of the installed fan(s) to the manufacturer for the warranty to be in effect.

C. The warranty shall not require the periodic submission of maintenance records for the warranty to remain in effect.

D. At project closeout, provide to Owner or Owner's Representative an executed copy of The manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

1.1 APPROVED MANUFACTURERS

A. Acceptable Manufacturer: MacroAir Technologies, Inc., Big Ass Fans, Skyblade, or approved equal.

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

1.2 COMMERCIAL / INDUSTRIAL HVLS FANS

A. Complete Unit
1. Regulatory Requirements: The entire fan assembly shall be NRTL-certified and built pursuant to the construction guidelines set forth by UL standard 507 and CSA standards 22.2 No. 60335-1 and 22.2 No. 113.
2. Sustainability Characteristics: The fan shall be designed to move an effective amount of air for cooling and destratification in industrial applications over an extended life. The fan components shall be designed specifically for high volume, low speed fans to ensure lower operational noise. Sound levels from the fan operating at maximum speed measured in a laboratory setting shall not exceed 55

dBA. Actual results of sound measurements in the field may vary due to sound reflective surfaces and environmental conditions.

3. Good workmanship shall be evident in all aspects of construction. Field balancing of the airfoils shall not be necessary.

B. Airfoil System
   1. The fan shall be equipped with six (6) Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers.
   2. The fan shall be equipped with six (6) Powerfoil winglets on the ends of the airfoils. The winglets shall be molded of a polypropylene blend. The standard color of the winglet shall be “BAF Yellow.”
   3. Airfoil Restraint System
      a. All fans shall be equipped with a patented airfoil restraint system to provide redundant safety between the ends of the airfoils and the fan hub. The airfoil restraint system shall be available as an option on smaller diameter fans.
      b. The airfoil restraint system shall be comprised of durable, lightweight nylon safety straps that shall extend from winglets through the airfoils and secure to the fan hub with 12-gauge stamped steel safety clips.
      c. The straps shall be made of 1 in. (24 mm) wide heavy-duty nylon webbing rated for 825 lb (374 kg). The loops at the ends of the straps shall be secured in a double-stitch pattern for reinforced durability.
      d. The straps shall be precisely matched to each fan’s diameter, eliminating the need for a tensioning mechanism and reducing the opportunity for noise.
      e. The straps shall run along the inside of the airfoils for an uninterrupted look.
      f. Safety clips shall secure to each winglet to comprise the outer anchor points and provide tension, while clips on the opposite end shall secure to threaded inserts incorporated in the fan hub.

C. Motor
   1. The fan motor shall be an AC induction type inverter rated at 1725 RPM, 100-125 VAC, 50/60 Hz, single-phase.
   2. The motor shall be totally enclosed, fan cooled (TEFC) with an IP56. A B5 standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in 5^{o} F to 104^{o} F (-15^{o} C to 40^{o} C) ambient conditions.

D. Gearbox
   1. The gearbox shall be a helical gear reducer, precision finished from hardened steel for low noise and long service life with double lip seals to retain oil and prevent contamination. The gearbox shall be lubricated for life. The gear reducer shall have a standard backlash of less than 25 arc minutes and be equipped with a 17-4 stainless steel shaft of 1-1/4” (3.2 cm) diameter.

E. Motor Frame
   1. The motor frame and mount shall be constructed of steel and powder coated for corrosion resistance and appearance.

F. Mounting System
   1. The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation. This design shall allow for adjustments to be made after the mount is

installed to the mounting structure to ensure the fan will hang level from the structure.
2. The upper mount shall be of ASTM A-36 steel, at least 3/16” thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.
3. All mounting hardware shall be SAE Grade 8 or equivalent.

G. Hub
1. The fan hub shall be 19” (48 cm) in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, six (6) aluminum spars, and one (1) aluminum spacer fastened with a pin and collar rivet system. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a large area to reduce the fatigue experienced at the attachment point for the fan blade.
2. The hub shall be secured to the output shaft of the gearbox by means of a steel coupling interface. The hub shall incorporate three (3) safety retaining clips made of 1/4” (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.

H. Safety Cables
1. The fan shall be equipped with an upper safety cable that provides an additional means of securing the fan assembly to the building structure. The upper safety cable shall have a diameter of Ø3/8” (1 cm).
2. The fan shall be equipped with two lower safety cables pre-attached to the fan hub that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 1/4” (0.6 cm).
3. The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).
4. Field construction of safety cables is not permitted.

I. Variable Frequency Drive
1. The Variable Frequency Drive (VFD) shall be a NEMA 4X VFD that is factory programmed to minimize starting and braking torques. The VFD shall have touchpad controls and an LED display for controlling the fan’s direction, operation, speed, and programming. The VFD may be equipped with an EMI/RFI filter to limit interference with other electronic equipment and a rotary switch disconnect for lock-out/tag-out requirements.
2. Onboard Variable Frequency Drive: The VFD may be mounted on the fan motor frame. A wall-mounted digital variable speed controller shall be provided for such installations, allowing access to all VFD functions.
3. Wall-Mounted Variable Frequency Drive: The VFD may be wall-mounted for ease of access.

J. Digital Variable Speed Wall Controller
1. The fan shall be equipped with a digital variable speed wall controller. The controller user interface shall be an intuitive touchscreen interface.
2. The controller shall be mounted to a standard rectangular or square outlet box.
3. A 150-ft (45.7-m) CAT5 cable shall be provided for connecting the controller to the fan’s VFD and to provide power to the controller.
4. The controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
5. The controller shall have an IP55 rating.

6. The controller shall provide fan start/stop, speed, and direction control functions.
7. The controller shall provide diagnostic and fault history information for the connected fan, as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.
8. The controller interface shall be able to be secured with a passcode to prevent unauthorized access to fan controls and settings.
9. The controller shall operate out of the box without setup and upon connection to CAT5 cable.

L. Fire Control Panel Integration
   1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

M. Guy Wires
   1. Included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

PART 3 EXECUTION

3.1 PREPARATION

A. Check accuracy of dimensions indicated for openings to receive fans.

B. Check location and availability of utility services to ensure proper voltage and installation preparation.

C. Coordinate location and installation of the HVLS Fans.

D. Ensure building structural members are sufficient to support the weight and operation of the fan. Consult professional engineer or registered architect as required.

3.2 INSTALLATION

A. Install units per manufacturer's written instructions.

B. Fan airfoil height to be a minimum of 10 feet from the floor in accordance with OSHA guidelines.

C. All safety and support features must be installed. These include any guy wires and safety cables as well as airfoil retainer locking features.

D. Adjust unit as required for proper operation in accordance with manufacturer’s installation instructions.

E. Securely anchor units.

F. Ensure that operating parts turn freely prior to initial startup.

G. Repair or replace damaged parts, dents, buckles, abrasions or other damage affecting appearance or serviceability, as acceptable to Architect.

3.3 PROTECTION

A. Protect finished Work until date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.4 CLEANING

A. Clean Work per Section 01 74 00.

B. Clean and inspect fans per manufacturer's instructions.

C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION 23 34 43

SECTION 23 37 13 - GRILLES, REGISTERS AND CEILING DIFFUSERS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

1.04 Refer to other Division-23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets and for balancing of air outlets and inlets; not work of this section.

1.05 Codes and Standards:

A. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual". Provide air outlets and inlets bearing ADC Certified Rating Seal.

B. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.06 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets indicating construction, finish, and mounting details.

B. Performance Data: For each type of air outlet and inlet furnished, provide aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections and data as required.

1.07 O&M Data Submittals: Submit cleaning instructions for finishes and spare parts lists. Include this data and a copy of approval submittals in O&M manual.

PART 2 PRODUCTS

2.01 General:

A. Except as otherwise indicated, provide manufacturer's standard grilles, registers, and ceiling diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Manufacturers not listed in the following specification will not be considered for

approval unless accepted by addendum prior to bid.

C. Performance: Provide grilles, registers and ceiling diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device equal to the basis of design.

D. Ceiling and Wall Compatibility: Provide grilles, registers and diffusers with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into ceiling module or wall with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems and walls which will contain each type of ceiling diffuser, grille, or register.

E. Appearance: All grilles and registers shall be aluminum construction and all diffusers shall be aluminum construction, unless otherwise noted, with uniform matching appearance for each type of outlet. Ceiling mounted grilles and registers shall be set to be sight tight from the predominant exposure.

F. Finish: All ceiling mounted grilles, registers, and diffusers shall be finished with baked white enamel. Wall and door mounted grilles and registers shall be finished with clear anodized finish .

2.02 Acceptable Manufacturers: Subject to compliance with requirements, provide products by Titus, Nailor Industries, or Metal Aire.

2.03 Rectangular Ceiling Diffusers (CD): Provide rectangular face with removable inner core, no corner joints. If square or rectangular neck is provided, provide square to round adaptor as required. Provide lay-in panel as required. Provide trim ring for diffusers in hard ceilings to allow opening to be used for access.

2.04 Return, Transfer, and Exhaust Grilles: Provide grilles with one set of 45 degree fixed louvers, parallel to the long dimension. Provide mounting frame for all wall and plaster ceiling installations.

PART 3 EXECUTION

3.01 Coordinate installation with ceiling and light fixture installation. Locate ceiling outlets as indicated on architectural Reflected Ceiling Plans. Unless otherwise indicated, locate ceiling outlets in the center of acoustical ceiling modules with sides parallel to the grid.

3.02 Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

3.03 Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

3.04 Set air volumes to values shown on the drawings so that the system is functional. Leave ready for test and balance contractor.

3.05 Furnish to Owner three operating keys for each type of outlet and inlet that require them; obtain receipt.

END OF SECTION 23 37 13

SECTION 23 37 26 - WALL LOUVERS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Extent of wall louver work is indicated by drawings and schedules, and by the requirements of this section.

1.04 Refer to other Division-23 sections for ductwork, duct accessories and controls work.

1.05 AMCA Compliance: Test and rate louvers in accordance with AMCA Standard 500. Provide AMCA certified rating seal. Ratings based on tests and procedures performed in accordance with AMCA 500-L and complying with the AMCA 511 Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance, water penetration and wind driven rain ratings.

A. Product Qualifications:

1. Miami-Dade County, Florida Notice of Acceptance (NOA).

2. Florida Building Code Approval.

3. Louver shall be certified to Florida Building Code Testing Application Standards TAS 100(A) (Wind Driven Rain Resistance), TAS 201 (Large Missile Impact), TAS 202 (Uniform Static Air Pressure) and TAS 203 (Cyclic Wind Loading).

4. AMCA Listed for compliance to AMCA 540 Level E and AMCA 550 standards.

1.06 Approval Submittals:

A. Product data: Submit manufacturer's technical product data for louvers including: model number, accessories furnished, construction, finish, mounting details, performance data.

1.07 O&M Data Submittals: Submit maintenance data, including cleaning of finishes and a copy of approval submittals. Include in O&M manual.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers: Subject to compliance with requirements, submit products

by Ruskin, Greenheck, Arrow, American Warming and Ventilating, Nailor Industries, or AMCA labeled approved equal.

2.02 General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Provide Kynar 500 coated, corrosion resistant finish and 5 year warranty; color to be selected by the Owner.

2.03 Substrate Compatibility: Provide louvers with 9 inch flanged frame, flange and sill extension piece that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver. Coordinate frame type with architect.

2.04 Materials: Construct of aluminum extrusions, Alloy 6063-T6 0.081” thick for frame and 0.081” thick for front blades and 0.060” thick for back blades. Weld units or use stainless steel fasteners.

2.05 Sill Flashing: Formed aluminum, 0.080” thick, upturned sides to prevent water leakage.

2.06 Installation Angles: Material: 1.375 x 2.25 inch x 0.125 inch thick continuous aluminum angles around louver perimeter for installation in concrete, deep CMU, steel and wood substrate wall systems.

2.07 Installation Plates: Material: 0.250 inch (6.4 mm) thick continuous aluminum flat or zee plates for installation in thin CMU substrate wall systems.

2.08 Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

2.09 Stationary Louvers: Hurricane and impact rated louvers, basis of design is Greenheck EHV-901D.

A. Performance Data:

1. Performance Ratings: AMCA licensed.

a. Based on testing 48 inches x 48 inches size unit in accordance with AMCA 500-L.

2. Free Area: 42 percent, nominal.

3. Free Area Size: 6.66 square feet.

4. Maximum Recommended Air Flow through Free Area: 2,155 feet per minute.

5. Air Flow: 10,431 cubic feet per minute.

6. Maximum Pressure Drop (Intake): 0.60 inches w.g..

7. Water Penetration: Beginning point of water penetration of 0.01 ounce per ft^2 of free area shall be above 1,250 feet per minute free area velocity.

8. Wind Load Rating: Maximum wind load of ±150 PSF.

9. AMCA 500-L Wind Driven Rain Performance: 99.9 percent effective at preventing water penetration through louver when tested at 50 miles per hour wind with 8 inches per hour rainfall and 2,155 feet per minute airflow through the free area. Penetration Class 'A' with Discharge Class (Intake) '3' in accordance with AMCA 500-L Wind Driven Rain Test.

PART 3 EXECUTION

3.01 Install where shown on the drawings in accordance with the manufacturer's printed instruction and Florida Product Approval. Exercise care to prevent scratches.

3.02 Isolate dissimilar metals per the manufacturer's recommendations.

3.03 Verify size of louvers shown on drawings prior to fabrication. Coordinate with wall openings. Sizes may be altered subject to approval by Engineer provided free area remains approximately the same as indicated.

END OF SECTION 23 37 26

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 43 18 - BI POLAR IONIZATION AIR CLEANING EQUIPMENT

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of air cleaning work required by this section is indicated on drawings and schedules, and by requirements of this section.

1.4 Refer to Division-23 air handling units section for filter boxes associated with air handling units; not work of this section.

1.5 Refer to Division-23 duct accessories section for duct access door work required in conjunction with air filters; not work of this section.

1.6 Refer to Division-26 sections for power supply wiring from power source to power connection on air filter units. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed by manufacturer.

1.7 Control wiring specified as work of Division 15 for Automatic Temperature Controls is work of that section.

1.8 Codes and Standards:

1.8.1 NFPA Compliance: Comply with applicable portions of NFPA 90A pertaining to installation of air filters.

1.8.2 UL Compliance: Comply with UL Standards pertaining to safety and performance of air filter units.

1.8.3 ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing, and for recording and calculating air flow rates.

1.9 Approval Submittals:

1.9.1 Product Data: Submit manufacturer's technical product data including dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.

BiPolar Ionization

1.9.2 Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, materials, and methods of assembly of components.

BiPolar Ionization

1.10 Test Reports and Verification Submittals:

1.10.1 Submit HEPA filter test reports.

1.11 O&M Data Submittals:

1.11.1 Maintenance Data: Submit maintenance data and spare parts lists for each type of filter and rack required. Include this data, product data and a copy of approval submittals in O&M manual.

1.11.2 Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air filter units. Submit manufacturer's ladder-type wiring diagram for control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed. Include in O&M manual.

2 PRODUCTS

2.1 BIPOLAR IONIZATION SYSTEM

2.1.1 The Air Purification System shall be a product of an established manufacturer within the USA.

2.1.2 A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.

2.1.3 Technologies that do not address gas disassociation such as UV Lights, Powered Particulate Filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. “Plasma” particulate filters shall not be acceptable.

2.1.4 Projects designed using ASHRAE Standard 62, IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2007 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted. The manufacturer shall provide independent test data on a previous installation performed within the last two years and in a similar application, that proves compliance to ASHRAE 62 and the accuracy of the calculations.

2.1.5 The Air Purification System have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved UL 867 prior to December 21, 2007 and have not been tested in accordance with the newest UL 867 standard with the ozone amendment shall not be acceptable. All manufacturers shall submit their independent UL 867 test data with ozone results to the engineer during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.

2.1.6 The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.007 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner’s output shall be no

more than 0.0042 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

2.1.7 Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve months after shipment or eighteen months from owner acceptance, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

2.1.8 General

The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be of the manufacturer specified.

Basis of Design: Global Plasma Solutions

Approved equals by Airgenics, Active Air Solutions, and Plasma Air subject to specification compliance. All other Suppliers of comparable products requesting prior approval shall:

Submit for prior approval in accordance with the requirements of Mechanical General.

In addition, manufacturers submitting for prior approval for Bi-Polar Ionization must as part of the prior approval request provide their ASHRAE 62.1-2007 calculations that prove conformance to the ASHRAE Standard with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third party validation study performed on a previous installation of the same application shall also be included.

Submit independent test data from ETL or UL showing ozone levels produced during the UL 867 ozone chamber test. Manufacturers without this test data shall not be acceptable.

2.1.9 Bi-Polar Ionization Design & Performance Criteria: Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a Plasma Generator with Bi-polar Ionization output as described here within.

2.1.10 The Bi-polar Ionization system shall be capable of:

Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).

Controlling gas phase contaminants generated from human occupants, building structure and furnishings.

Capable of reducing static space charges.

Increasing the interior ion levels, both positive and negative, to a minimum of 800 ions/cm^3 measured 5 feet from the floor.

2.1.11 The bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable.

Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.

Velocity Profile: The air purification device shall not have maximum velocity profile.

2.1.12 Humidity: Plasma Generators shall not require preheat protection when the relative humidity of the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions within the air purification system. Air purification system shall be capable of wash down duty.

2.1.13 Equipment Requirements:

Electrode Specifications (Bi-polar Ionization):

Each Plasma Generator with Bi-polar Ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity. A minimum of one electrode pair per 2400 CFM of air flow shall be provided. Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.

Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Internal circuitry shall be provided to sense air flow across the electrode output. Ionization systems requiring the use of a mechanical air pressure switch to cycle the electrodes only when the fan is operating shall not be acceptable due to high failure rates and pressure sensitivity.

2.1.14 Air Handler Mounted Units: Plasma Generator(s) shall be supplied and installed. The mechanical contractor shall mount the Plasma Generator and wire it to the AHU control power (24VAC) as instructed by the Air Purification Manufacturer's instructions or line voltage subject to power available. Each unit shall be designed with a stainless steel casing, integral illuminated on/off switch, two 2.5mm DC power jacks, high voltage output indication light and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per AHU is required to interface to the BAS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output is actually operating, are not acceptable.

2.1.15 Ionization Requirements: Plasma Generators with Bi-polar ionization output shall be capable of controlling gas phase contaminants and shall be provided for all equipment listed above. The Bi-polar ionization system shall consist of Bi-Polar Plasma Generator and power supply. The Bi-polar system shall be installed where indicated on the plans or specified to be installed. The device shall be capable of being powered by DC power or 24VAC or 110VAC to 240VAC without the use of an external transformer. Ionization systems requiring isolation transformers shall not be acceptable.

Ionization Output: The ionization output shall be controlled such that an equal number of positive and negative ions are produced. Imbalanced levels shall not be acceptable.

Ionization output from each electrode shall be a minimum of 15 million ions/cc when tested at 2" from the ionization generator.

All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:

MRSA - >96% in 30 minutes or less
E.coli - > 99% in 15 minutes or less
TB - > 69% in 60 minutes or less

Manufacturers not providing the equivalent space kill rates shall not be acceptable. All manufactures requesting prior approval shall provide to the engineer independent test data from a NELEC accredited independent lab confirming kill rates and time meeting the minimum requirements stated in section 2.2 B, points 6A, 6B and 6C. Products tested only on Petri dishes to prove kill rates shall not be acceptable.

2.1.16 Ozone Generation: The operation of the electrodes or Bi-polar ionization units shall conform to UL 867-2007 with respect to ozone generation. There shall be no ozone generation during any operating condition, with or without airflow.

2.1.17 Electrical Requirements: Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. Plasma Generator shall accept an electrical service of 24 VAC or 100 VAC to 240VAC, 1 phase, 50/60 Hz.

2.1.18 The contractor shall coordinate electrical requirements with air purification manufacturer during submittals.

2.1.19 Control Requirements:

All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset.

Integral airflow sensing shall modulate the Plasma output as the air flow varies or stops.

A mechanical air flow switch shall not be acceptable as a means to activate the Plasma device due to high failure rates and possible pressure reversal.

The installing contractor shall mount and wire the Plasma device within the air handling unit specified or as shown or the plans. The contractor shall follow all manufacturer IOM instructions during installation.

3 EXECUTION

3.1 General: Comply with installation requirements as specified elsewhere in these specifications pertaining to air filters housing/casings, and associated supporting devices.

3.2 AIR PURIFICATION SYSTEM

3.2.1 General: The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

3.2.2 Assembly & Erection: Plasma Generator With Bi-Polar Ionization

All equipment shall be assembled and installed in a workman like manner to the satisfaction of the owner, architect, and engineer.

Any material damaged by handling, water or moisture shall be replaced, by the mechanical contractor, at no cost to the owner.

All equipment shall be protected from dust and damage on a daily basis throughout construction.

3.2.3 Testing: Provide the manufacturers recommended electrical tests.

3.2.4 Commissioning & Training: A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

3.3 Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-21 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

END OF SECTION 23 43 18

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 54 16 - GAS-FIRED HEATING UNITS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Extent of gas-fired heating unit work required by this section is indicated on drawings and schedules, and by requirements of this section.

1.3 Refer to appropriate Division-23 sections for fuel piping; controls, ductwork; and testing, adjusting, and balancing in connection with gas-fired heating units; not work of this section.

1.4 Refer to Division-26 sections for the following; not work of this section.

1.4.1 Power supply wiring from power source to power connection on gas-fired heating units. Include starters, disconnects, and required electrical devices, except where specified as furnished, factory-installed, by manufacturer.

1.5 Refer to other Division-23 sections for automatic temperature controls not factory-installed, required in conjunction with gas-fired heating units; not work of this section.

1.6 Codes and Standards:

1.6.1 ANSI Compliance: Construct and install gas-fired heating units in accordance with latest ANSI standards.

1.6.2 NFPA Compliance: Install fuel gas piping and gas-fired heating units in accordance with NFPA 54 "National Fuel Gas Code".

1.6.3 AGA Compliance: All units shall be AGA certified.

1.7 Approval Submittals:

1.7.1 Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions. Submit manufacturer's assembly-type drawings indicating dimensions, required clearances, and methods of assembly of components.

Furnaces
Infrared Heaters
Vibration isolation

1.7.2 Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for gas-fired heating units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that

are factory-installed and portions to be field-installed.

1.8 O&M Data Submittals: Submit maintenance data and parts list for makeup air units, unit heaters, furnaces, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data and a copy of approval submittals in O&M manual.

2 PRODUCTS

2.1 Gas Fired Infrared Heaters: Gas-fired infrared space heaters shall be furnished and installed in accordance with governing codes and as shown per building drawing(s) as described below:

2.1.1 The heaters shall utilize factory assembled, highly-efficient aluminum reflectors with a reflectivity of 97.5% and designed for U-tube heaters. The tube body and u-bend shall be totally enclosed with a single reflector to maximize emitter temperature and radiant heat exchange between the firing and exhaust legs. In addition, the reflector ends shall be enclosed for maximum radiant heat output and minimum convection losses. The single reflector design shall cover the firing and exhaust legs as well as the entire u-bend. U-tube configuration made of straight tubes with individual reflectors covering the firing and exhaust legs shall not be accepted.

2.1.2 The heater's emitter tube shall operate at a maximum surface temperature of 750ºF and shall be made of 4” O.D. 16-gauge calorized aluminized steel or calorized titanium alloy Alumi-Therm steel for long life. The emitter tube shall be calorized for longevity, corrosion resistance, high humidity, harsh environment installations (outdoor covered patios and restaurants, wash bays, golf driving ranges etc.) and high radiant efficiency. The measured surface emissivity shall be 0.83-0.86 at operating temperature. The calorization process shall produce an emitter tube that is highly radiant absorptive on the interior (0.95) and highly radiant emissive (0.83-0.86) on the exterior. The system shall have a radiant efficiency (or radiant coefficient) of 65%.

2.1.3 To assure a high degree of safety and increased radiant efficiency, the heaters shall operate under negative pressure at all times during operation to preclude the escape of combustion gases inside the building. The heater exhaust assembly shall include a 120-volt draft inducer. The draft inducer shall be equipped with a permanently lubricated, totally enclosed and shielded, fan cooled, and heavy-duty ball bearing motor. The motor shall not require maintenance or lubrication for the life of the unit. The draft inducer assembly shall be capable of rotating 90º for vertical or horizontal venting.

2.1.4 Heaters shall be equipped with a 24-volt direct spark ignition with automatic 100%shutoff system. Power supplied to each heater shall be 120 VAC, 60 Hz. The heater controls shall include a pressure switch designed to provide complete unit shutoff in the event of combustion air or flue blockage. The heaters shall be equipped with an on-line diagnosis monitoring light system. The three lights shall monitor the power to the heater, insufficient airflow, and the spark ignition and the combination gas valve operation.

2.1.5 The heaters shall be factory assembled and tested. The only field assembly required is connecting the control/exhauster assembly to the factory assembled body section. This will minimize field assembly to 15 minutes per heater, which will minimize

installation cost. The heaters shall not require any field wiring or adjustments to assure maximum performance and safety.

2.1.6 The heater's burner shall consist of a heavy-duty cast iron atmospheric burner. The flame characteristics shall be highly luminous for maximum radiant heat transfer through the emitter tube wall.

2.1.7 The heaters will be CSA design certified for vertical or horizontal venting, maximum 75 feet horizontal sidewall venting, and for 50 feet outside combustion inlet duct. There shall be no draft hoods. The combustion chamber shall be totally enclosed.

2.1.8 Heaters shall operate satisfactorily in any position from horizontal to forty-five degrees (45º) from horizontal, and shall be suitable for vented/indirect vented applications. Heaters shall be designed to operate on natural gas.

2.1.9 Heaters shall be design certified by the Canadian Standards Association (CSA) to American National Standard Z83.20/CSA2.34. The manufacturer shall provide a written limited warranty covering the heavy one-piece cast iron burner for a period of ten (10) years, the emitter tube for a period of five (5) years, and all components utilized in the heater's control assembly for a period of one (1) year.

2.1.10 Provide the following accessories:

High gas line pressure regulator.
Low voltage, 2-stage room thermostat and 2-stage gas valve.

2.1.11 Acceptable Manufacturers: Subject to compliance with requirements, provide gas-fired make up air units of one of the following:

Spaceray (Gas Fired Products Inc.)
Reznor.
Advanced Radiant
Approved Equal

2.2 Gas Vents: Provide stainless steel double wall gas vent system for gas-fired appliances, except where noted otherwise on the drawings. The system shall include pipe, top, flashing cone, storm collar, joist shield, support plates, firestops, and fittings as required by the manufacturer for a complete installation. Acceptable Producers: Metalbestos, Hart and Cooley or approved equal.

2.3 Fresh Air Vent Piping: Provide galvanized vent pipe for fresh air intake complying with the manufacturer’s requirements.

2.4 Basic Vibration Isolation: Provide vibration isolation products complying with Division-23 section "Vibration Isolation” and the following listing:

3 EXECUTION

3.1 Examine areas and conditions under which gas-fired heating units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 General: Install gas-fired heating units as indicated, and in accordance with manufacturer's published installation instructions.

3.3 Hang units from substrate using threaded rods and building attachments, secure rods to unit hanger attachments. Adjust hangers so unit is plumb and level.

3.4 Installation: Install in accordance with producer's printed instructions.

3.5 Clearances: Install units so that manufacturer's required clearance are maintained.

3.6 Cleaning: Clean tar and all other soil from housing exterior. Leave ready for Division 7, Caulking Work.

3.7 Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.8 Duct Connections: Refer to other Division-23 sections. Provide ductwork, accessories, and flexible connections as indicated.

3.9 Gas Vents:

3.9.1 Install gas vents for all induced draft gas-fired appliances in accordance with NFPA 54 and the manufacturer's instructions. Provide all flashing and related materials.

3.9.2 Gas vents shall terminate at least 3 feet above combustion air inlets.

3.9.3 Slope horizontal gas vent connectors upward at least ¼ inch per foot.

3.10 Coordinate installation of gas piping to ensure that proper gas pressure is available and that gas piping union, drip leg and runout do not interfere with servicing or removal of unit.

3.11 Startup: Check entire assembly for correctness of installation, alignment, and control sequencing. Start all component parts in proper sequence. Make all adjustments required to insure proper smooth quiet operation.

3.12 Provide one spare set of belts for each belt-driven fan, obtain receipt from Owner that belts have been received.

3.13 Provide one complete extra set of filters for each unit. Install new filters at completion of work, and prior to testing, adjusting, and balancing work. Obtain receipt from Owner that new filters have been installed.

END OF SECTION 23 54 16

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 81 03 - OUTSIDE AIR PRECONDITIONING UNITS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Refer to other Division-23 sections for testing, adjusting, and balancing of air conditioning units (OAUs).

1.04 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data, including dimensions, ratings, electrical characteristics, weight, capacities, materials of construction, and installation instructions.

Preconditioning units
Vibration isolation
Refrigerant Line Shop Drawings

1.05 Test Reports and Verification Submittals:

A. Submit Startup Report by factory-trained representative.

1.06 O&M Data Submittals: Submit manufacturer's maintenance data including parts lists. Include these data, a copy of approval submittals, product data, and wiring diagrams in O&M manual.

PART 2 PRODUCTS

2.01 Quality Assurance:

A. Provide units tested by UL, ARL or ETL.

B. Construct refrigeration system in accordance with ASHRAE 15 (ANSI B 9.1) "Safety Code for Mechanical Refrigeration".

C. Provide units with an EER that meets the Florida Energy Efficiency Code and the schedules on the drawings.

D. Acceptable Manufacturers: Subject to compliance with requirements provide units by Dectron, Desert-Aire, or Annexair.

2.02 General:

A. Units shall be factory-assembled, wired and tested. All controls shall be factory-adjusted and preset to the design conditions.

B. Casings: Construct of heavy gauge steel formed panels rigidly reinforced and braced. Each unit shall be provided with removable panels to permit the unit (including fans and compressors) to be properly maintained and serviced. Entire casing shall be painted with factory-applied finish. Casing for outdoor units shall be provided with weatherproof construction with all seams bolted. Provide stainless steel hardware. Units shall be sealed to minimize leakage.

2.03 Remote Condenser:

A. The size and capacity shall be in accordance with the unit schedule. The system shall be able to reject all the recovered heat (THR) to the outdoor condenser.

B. The unit shall be provided with a weatherproof electrical panel with factory mounted door interrupt disconnect switch.

C. The cabinet shall be constructed of heavy-gauge aluminum. The sides shall be one-piece construction. The unit shall be provided with lifting eyes located on the fan discharge panel.

D. The coil shall be constructed of copper tubing in a staggered design. Tubes shall be hydraulically expanded into full-collared, plate-type aluminum fins. Coils shall be factory lea-tested and sealed with caps.

E. The fan motors shall be heavy-duty PSC or three-phase with permanently lubricated ball bearings and built-in overload protection. All motors shall be factory-wired with leads terminating in a weatherproof junction box located on the outside of the unit cabinet.

F. The fan diameter shall not exceed 30”. All units shall have a dynamically balanced fan with aluminum blades and painted steel hubs.

G. The fans shall be cycled based on internal head pressure on multiple fan units.

H. Fan guards shall be heavy-gauge, closed-mesh steel wire with vinyl coating. Guards shall be contoured for maximum rigidity.

I. The condenser shall use a low 1140 RPM motor designed fan blade to produce 85 dbA or less noise at 10 ft.

J. Compressor: Shall be scroll design for R410a refrigerant with vibration isolation. Each compressor shall have separate refrigerant circuit. Motors shall be ball bearing, high starting torque, low starting current type for compressor service. Compressors shall not produce objectionable noise or vibration inside the building. Compressors shall have five (5) year warranty.

K. Service Valves: Provide for high and low pressure readings.

L. Equipment Coating: Provide clear inorganic reacted siloxane coating over all surfaces of the unit exposed to the outdoors, MicroGuard AD35 by Adsil or equal. Completely coat condenser coils, base pan, cabinet, and all exposed refrigerant parts, covers, and shields. Provide 6 to 8 micron dry film thickness and all

cleaning, prep, and finish work required for first class installation. Provide 3 year warranty on the coating. Provide 72 hour notice to engineer for witnessing of field applied coatings.

2.04 Indoor Unit:

A. Enclosure:

1. A 12-gauge galvanized base panel shall be incorporated in all units. Panels shall be a minimum of 20-gauge galvanized steel. Supports shall be constructed of a minimum 16-gauge galvanized steel.

2. Removable panels shall be provided to allow easy access to all internal parts and components. The electrical control box and switch panel shall be enclosed in a separate compartment.

3. 4-15 Ton Cabinets: The thermal and sound insulation shall be 3/4" closed cellular rubber insulation installed in the upper air handling section.

4. 20-30 Ton Cabinets: The unit shall be double wall with 16-gauge galvanized outer panels and 20-gauge inner liners. The insulation shall be 1" solid foam in the double wall cabinet with a minimum R value o 5.0.

B. Refrigeration System:

1. Compressors (4 and 5 HP): The compressor shall be heavy-duty scroll type, single compressor complete with start kit on single-phase motors. The compressor shall be equipped with low and high-pressure safety switches, with internal protection from overheating. The compressor shall be externally vibration isolated. The unit shall be provided with hot gas bypass for each system compressor.

2. Compressors (8 to 30 HP): The compressors shall be a tandem pair, heavy-duty scroll type. A factory-mounted suction line sensor that will deactivate one compressor when the load reaches the mid-range of the system's capacity shall stage the compressors. The compressor shall be equipped with high and low pressure safety switches, with internal protection from overheating. The compressor shall be externally vibration isolated.

3. Hot Gas Bypass: The unit shall include hot gas bypass for each system compressor set. The hot gas bypass is to be used only for coil freeze protection and not for compressor unloading.

4. Receiver: The unit shall include a refrigerant receiver. The receiver shall assist the unit in operating at the highest efficiency over a wide range of load conditions.

5. Evaporator Dehumidifier Coils:

6. Fins: Fins shall be die-formed, raised lanced aluminum, and be damage resistant. Fin collars shall be extruded. Fin spacing shall not exceed 10 FPI.

7. Tubes: Coil shall be fabricated from seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability. The coil shall be a minimum of six rows deep. Coils shall be leak tested with 540 psig of nitrogen.

8. Reheat Coil: Finish shall be die-formed, raised lanced aluminum and shall be damage resistant. Fin spacing shall be no greater than 12 FPI. Coil tubes shall be seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability. Leak test with 625 psig of nitrogen. The coil shall be a minimum of 2 rows, located a minimum of 5" from the evaporator coil.

C. Electric Heater:

1. Capacity shall be in accordance with unit schedule. The heater coils shall be constructed of high grade nickel-chrome allow and insulated by floating ceramic bushings from the galvanized steel frame. Coil terminal pins shall be stainless steel insulated by means of non-rotating ceramic bushings. The heater shall be equipped with fail-safe, automatic reset and manual reset disc-type thermal cutouts. The unit shall be wired to the units main power lugs to provide a single point of connection for unit power.

D. Air Filters: Provide 4" filter rack with MERV 8 disposable filters. Provide two sets of filters—one for construction and one to be installed at substantial completion.

2.05 Controls:

A. All safety and operational controls shall be factory wired and preset in a control panel in a separate compartment. Provide all necessary operational controls to heat, cool and dehumidify 100% outside air in accordance with the control diagrams on the drawings and the sequence of operation.

B. Safety and Operational Control Features:

Internal compressor overtemperature protection.
Hot gas reheat and thermostat to maintain supply air temperature.
Solid state adjustable trip overloads.
High pressure cutout.
Low pressure cutout.
Anti-recycle time delay start.
Phase failure and low voltage protection.
Hot gas bypass.
SCR controller for head pressure control.
Outside air thermostat to control compressor.
Thermal expansion valve.
Connection for remote on-off control.

2.06 Coil Coating: Provide factory applied ElectroFin E-Coating or equal on condenser, evaporator, and reheat coils. The coating shall be applied to the entire coil assembly. The coil shall be sealed, electro-statically charged, coated, and baked. Provide two

year parts warranty on coated coils.

2.07 Refrigerant Piping:

A. Copper tubing ¾" and smaller: Type ACR, soft annealed temper; cast copper-alloy fittings for flared copper tubes; flared joints.

B. Copper tubing 7/8" – 4-1/8": Type ACR, hard-drawn temper tubing; wrought-copper, solder-joint fitting; brazed joints.

C. Silver solder material: Silver solder bearing at least 15% silver; Sil Fos.

2.08 Basic Vibration Isolation: Provide vibration isolation products complying with Division-23 section "Vibration Isolation" and the following list:

A. Equipment Mounting: Type EM1

2.09 Warranty: Manufacturer shall provide two year parts and labor warranty. \

2.10 Sequence of Operation:

The following sequence of operations shall be provided by the unit manufacturer:

General: Starting and stopping of equipment shall be by a unit mounted digital controller. With the digital controller enabled by a signal from the building electronic programmable time clock, the unit shall be started automatically by the electronic control system and all controls activated subject to the fire alarm relay, safeties and overloads.

Occupied Mode Dehumidification: The motorized OA damper shall open to the balanced position and the indoor fan shall run continuously. The unit shall dehumidify supply air anytime the outdoor air dewpoint is above 55ºf. The unit shall modulate the hot gas reheat to maintain 72F leaving air temperature.

Occupied Mode Heating: When the outdoor air temperature falls below 50ºf, the electric heat shall operate as required to maintain the leaving air temperature at 65F. The electric heat shall be locked out during cooling.

Unoccupied Mode: The motorized OA damper shall close and the unit shall be not operate.

Override Mode: the override mode shall place the system in occupied mode and the outside air damper for the unit in override shall open to the balanced position.

2.11 Shop Drawings: Provide scaled factory approved refrigerant line layout showing the actual routing on site, including all elevation changes and elbows. Drawings should indicate total length and size of refrigerant piping between indoor and outdoor units and elevations for indoor and outdoor equipment.

PART 3 EXECUTION

3.01 Installation: Install in accordance with producer's printed instructions. Brush out fins on all coils.

3.02 Mount units on vibration isolation and concrete housekeeping pads.

3.03 Refrigerant Piping: Comply with ANSI B31.5, “Refrigerant Piping,” (except lower pressure limits below 15 psig), and ASHRAE 15 (ANSI B9.1). Make all joints carefully and neatly. Clean pipe and fittings before fluxing. Remove burrs. Braze by the sweat method using Sil Fos. Install field installed refrigerant devices and valves as required.

A. Refrigerant Piping Layout: Any deviations from the factory approved shop drawings shall be approved by the factory prior to system startup.

3.04 Testing: After job erection, or modification of factory installed piping, pressure test for leaks at 150 psig using a nominal amount of a suitable tracer refrigerant and dry nitrogen or a suitable refrigerant. Perform leak tests with an electronic halide leak detector having a sensitivity of at least ½ ounce R-12 per year. Refrigeration piping will not be accepted unless it is gas tight.

3.05 Evacuation: After completing the successful pressure test, multiple-evacuate the system. Leave the compressor isolation valves shut and connect the vacuum pump to both the high and low sides. Evacuate the system to an absolute pressure of 1,500 microns. Then break vacuum to 2 psig with dry nitrogen. Repeat this process. Install the proper biflow drier in the liquid line and evacuate the system to 500 microns. Leave vacuum pump running for at least two hours without interruption. Break vacuum with the refrigerant to be used and raise pressure to 2 psig. Do not operate compressors during the evacuation procedure.

3.06 Charging: After completing the successful evacuation procedure, charge refrigerant directly to the system from the original containers through a filter drier. Charge to the manufacturer’s stated conditions of pressure for required temperature. Weigh the refrigerant added and record on the startup report.

3.07 Controls: Set up controls for units as described in Sequence of Operations.

3.08 Cleaning: Clean tar and all other soil from housing exterior. Leave ready for Division 7, Caulking Work. Caulk around pipe sleeves.

3.09 Construction Filters: Provide 4" thick filters in all units during construction. After construction (but prior to the test and balance being performed) install clean final filters.

3.10 Condensate Drain: Pipe trapped copper condensate drain (full size of unit outlet) to nearest floor drain or as shown on the drawings. Refer to Division-23 section "Insulation" for pipe insulation.

3.11 Startup: Startup by a factory-trained representative. Check entire assembly for correctness of installation, alignment, and control sequencing. Start all component parts in proper sequence. Make all adjustments required to insure proper control and smooth quiet operation. Submit Startup Report.

END OF SECTION 23 81 03

PANAMA CITY BEACH
FIRE STSTION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 81 26 - AIR SOURCE UNITARY SPLIT SYSTEM HEAT PUMP UNITS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Refer to other Division-23 sections for testing, adjusting, and balancing of air conditioning units (AHUs).

1.04 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data, including dimensions, ratings, electrical characteristics, weight, capacities, materials of construction, and installation instructions.

1. Split system units
2. Vibration Isolation

1.05 O&M Data Submittals: Submit manufacturer's maintenance data including parts lists. Include these data, a copy of approval submittals, product data, and wiring diagrams in O&M manual.

PART 2 PRODUCTS

2.01 Quality Assurance:

A. Provide units tested by UL, ARL or ETL.

B. Construct refrigeration system in accordance with ASHRAE 15 (ANSI B 9.1) "Safety Code for Mechanical Refrigeration".

C. Test and rate AHUs in accordance with the applicable ARI standards and provide certified rating seal. Sound test and rate units in accordance with ARI 270.

D. Provide units with an EER or SEER that meets the Florida Energy Efficiency Code and the schedules on the drawings.

E. Acceptable Manufacturers: Subject to compliance with requirements provide units by: Carrier, Trane, Lennox, York or approved equal.

2.02 General:

A. Units shall be factory-assembled, wired and tested. All controls shall be factory-adjusted and preset to the design conditions.

B. Casings: Construct of heavy gauge steel (or aluminum) formed panels rigidly reinforced and braced. Each unit shall be provided with removable panels to permit the unit (including fans and compressors) to be properly maintained and serviced. Entire casing shall be painted with factory-applied finish. Casing for outdoor units shall be provided with weatherproof construction with all seams bolted. Provide stainless steel hardware.

C. Supports: Provide individual concrete pad for each unit 4" larger than the unit on all sides.

2.03 Condensing Unit:

A. Condenser Fans and Drives: Fan shall of rustproof construction: hot-dipped galvanized steel, stainless steel or aluminum. Unit shall have a variable speed motor suitable for the duty indicated. Provide a close fretwork galvanized steel or non-ferrous fan and guard. Motors shall be the permanently lubricated type, resiliently mounted.

B. Condenser Coil: Construct of copper nonferrous tubes and nonferrous fins. Provide inlet guard to protect condenser fins. Provide seacoast or heresite coating on the condenser coil.

C. Compressor: Shall be scroll hermetic or semi-hermetic reciprocating design for R410a refrigerant with vibration isolation. Each compressor shall have separate refrigerant circuit. Motors shall be ball bearing, high starting torque, low starting current type for compressor service. Compressors shall not produce objectionable noise or vibration inside the building. Compressors shall have five (5) year warranty. Provide dual compressor machines if scheduled.

D. Service Valves: Provide for high and low pressure readings.

E. Equipment Coating: Provide clear inorganic reacted siloxane coating over all surfaces of the unit exposed to the outdoors, MicroGuard AD35 by Adsil or equal. Completely coat condenser coils, base pan, cabinet, and all exposed refrigerant parts, covers, and shields. Provide 6 to 8 micron dry film thickness and all cleaning, prep, and finish work required for first class installation. Provide 3 year warranty on the coating. Provide 72 hour notice to engineer for witnessing of field applied coatings.

2.04 Evaporator Unit:

A. Interior of unit shall be thermally and acoustically insulated with minimum R=4.2 insulation. . Provide removable panels to permit the unit to be properly serviced and maintained.

B. The evaporator shall include centrifugal fan, fan motor, direct drive and lubricated bearings. Motors shall be high efficiency type. Provide cooling coils constructed of copper tubes and aluminum fins. Filters and coils shall be selected for a maximum face velocity of 500 fpm. Provide thermal expansion valve, sight glass, refrigerant drier, strainer, controls and other necessary devices for a completely automatic unit.

C. Each unit shall be equipped with sloped IAQ drain pans under the entire evaporator

coil to prevent condensate carry-over.

2.05 Electric Heater Section:

A. Provide electric heating coils controlled by one or more magnetic contactors. Three phase coils shall be wired for balanced current in each wire, if possible. Furnish and install necessary overheating and air flow controls to meet the requirements of the National Electric Code. Provide built-in air flow switch and heater interlock relay.

B. Heaters shall be factory mounted and wired with all required fuses and contactors to provide single point connection.

2.06 Unit Controls:

A. All safety and operational controls shall be factory wired.

B. Safety and Operational Control Features:

Internal compressor overtemperature protection.
Crankcase heaters.
Individual motor overcurrent protection.
High pressure cutout.
Low pressure cutout.
Anti-recycle timer (5 minute)
Timer-type defrost control.
Liquid line solenoid.

2.07 Refrigerant Piping:

A. Copper tubing 3/4" and smaller: Type ACR, hard-drawn temper tubing; wrought-copper, solder-joint fitting; brazed joints.

B. Copper tubing 7/8" – 4-1/8": Type ACR, hard-drawn temper tubing; wrought-copper, solder-joint fitting; brazed joints.

C. Silver solder material: Silver solder bearing at least 15% silver; Sil Fos.

2.08 Basic Vibration Isolation: Provide vibration isolation products complying with Division-23 section "Vibration Isolation" and the following list:

A. Equipment Mounting (Indoor): Type EM5

PART 3 EXECUTION

3.01 Installation: Install in accordance with producer's printed instructions. Brush out fins on all coils.

3.02 Support: Mount units on concrete pads with manufacturer’s recommended service and operating clearance.

3.03 Mount units on vibration isolation.

3.04 Brush out fins on all coils.

3.05 Refrigerant Piping: Comply with ANSI B31.5, “Refrigerant Piping,” (except lower pressure limits below 15 psig), and ASHRAE 15 (ANSI B9.1). Make all joints carefully and neatly. Clean pipe and fittings before fluxing. Remove burrs. Braze by the sweat method using Sil Fos. Install field installed refrigerant devices and valves as required.

3.06 Testing: After job erection, or modification of factory installed piping, pressure test for leaks at 150 psig using a nominal amount of a suitable tracer refrigerant and dry nitrogen or a suitable refrigerant. Perform leak tests with an electronic halide leak detector having a sensitivity of at least ½ ounce R-12 per year. Refrigeration piping will not be accepted unless it is gas tight.

3.07 Evacuation: After completing the successful pressure test, multiple-evacuate the system. Leave the compressor isolation valves shut and connect the vacuum pump to both the high and loq sides. Evacuate the system to an absolute pressure of 1,500 microns. Then break vacuum to 2 psig with dry nitrogen. Repeat this process. Install the proper biflow drier in the liquid line and evacuate the system to 500 microns. Leave vacuum pump running for at least two hours without interruption. Break vacuum with the refrigerant to be used and raise pressure to 2 psig. Do not operate compressors during the evacuation procedure.

3.08 Charging: After completing the successful evacuation procedure, charge refrigerant directly to the system from the original containers through a filter drier. Charge to the manufacturer’s stated conditions of pressure for required temperature. Weigh the refrigerant added and record on the startup report.

3.09 Construction Filters: Provide 1" thick filters in all units during construction. After construction (but prior to the test and balance being performed) install clean final filters.

3.10 Cleaning: Clean tar and all other soil from housing exterior. Leave ready for Division 7, Caulking Work. Caulk around pipe sleeves.

3.11 Condensate Drain: Pipe trapped copper condensate drain (full size of unit outlet) to nearest floor/roof drain or as shown on the drawings. Refer to Division-23 section "Insulation" for pipe insulation.

3.12 Startup: Check entire assembly for correctness of installation, alignment, and control sequencing. Start all component parts in proper sequence. Make all adjustments required to insure proper smooth quiet operation.

END OF SECTION 23 81 26

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 81 28 - DUCTLESS SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Refer to other Division-23 sections for testing, adjusting, and balancing of units; not work of this section.

1.04 Approval Submittals:

A. Product Data: Submit manufacturer's technical product data, including dimensions, ratings, electrical characteristics, weight, capacities, materials of construction, and installation instructions. Submit assembly-type drawings showing all piping and electrical connections and all mounting requirements. Show methods of fastening and assembly of components. Provide wiring diagrams.

1.05 O&M Data Submittals: Submit manufacturer's maintenance data including parts lists. Include these data, product data, and a copy of approval submittals in O&M manual.

PART 2 PRODUCTS

2.01 Quality Assurance:

A. Test and rate split system air conditioning units in accordance with ARI Standard 210, 240 or 360 as applicable, and provide certified rating seal.

B. Construct refrigeration system of split system air conditioning units in accordance with ASHRAE 15 (ANSI B 9.1) "Safety Code for Mechanical Refrigeration".

C. Provide split system air conditioning units with an SEER that meets the Florida Energy Efficiency Code and the schedule on the drawings.

D. Provide split system air conditioning units that are designed, manufactured, and tested in accordance with UL or ETL requirements.

E. Acceptable Manufacturers: Submit to compliance with requirements, provide units by Daikin, Sanyo, Toshiba, Mitsubishi, or approved equal.

2.02 General:

A. Casings: Construct of painted mill galvanized steel (or aluminum) formed panels rigidly reinforced and braced. Each unit shall be provided with removable panels

to permit the unit (including fans and compressors) to be properly maintained and serviced.

2.03 Condensing Unit:

A. Condenser Fans and Drives: Fan shall be of rustproof construction, hot dipped galvanized steel, stainless steel or aluminum. Unit shall have weather protected totally enclosed motor. Provide a close fretwork galvanized steel or non-ferrous fan guard. Motors shall be the permanently lubricated type, resiliently mounted.

B. Condenser Coil: Construct of non-ferrous tubes and aluminum fins. Provide inlet guard to protect condenser fins. Provide seacoast coating on coils.

C. Compressor: Shall be scroll or hermetic design with vibration isolation. Compressor shall not produce objectionable noise or vibration inside the building. Compressors shall have five (5) year warranty.

D. Service Valves: Provide for high and low pressure readings.

2.04 Evaporator Unit:

A. Interior of unit shall be thermally and acoustically insulated with 1 inch fiberglass duct liner insulation. Provide removable panels to permit the unit to be properly serviced and maintained.

B. The evaporator section shall include centrifugal fan, two-speed fan motor, and direct drive. Provide cooling coil, snap out washable filters, refrigerant drier, controls and other necessary devices for a completely automatic unit. Coils shall have copper tubes and aluminum fins. Provide automatic oscillating louver action to facilitate air distribution.

2.05 Controls:

A. All safety and operational controls shall be factory wired.

B. Provide remote microprocessor-based controls with room thermostat, timer and fan speed switch.

2.06 Refrigerant Piping:

A. Copper tubing 3/4" and smaller: Type ACR, soft annealed temper; cast copper-alloy fittings for flared copper tubes; flared joints.

B. Brazing material: Silver solder bearing at least 15% silver; Sil Fos.

PART 3 EXECUTION

3.01 Installation: Install in accordance with producer's printed instructions.

3.02 Refrigerant Piping: Comply with ANSI B31.5, "Refrigerant Piping," (extend lower pressure limits below 15 psig), and ASHRAE 15 (ANSI B9.1). Make all joints carefully and neatly. Clean pipe and fittings before fluxing. Remove burrs. Braze by the sweat method using Sil Fos.

3.03 Testing: After job erection, pressure test for leaks at 150 psig using a nominal amount of a suitable tracer refrigerant and dry nitrogen or a suitable refrigerant. Perform leak tests with an electronic halide leak detector having a sensitivity of at least 1/2 ounce R-12 per year. Refrigeration piping will not be accepted unless it is gas tight.

3.04 Evacuation: After completing the successful pressure test, multiple-evacuate the system. Leave the compressor isolation valves shut and connect the vacuum pump to both the high and low sides. Evacuate the system to an absolute pressure of 1,500 microns. Then break vacuum to 2 psig with dry nitrogen. Repeat this process. Install the proper biflow drier in the liquid line and evacuate the system to 500 microns. Leave vacuum pump running for at least two hours without interruption. Break vacuum with the refrigerant to be used and raise pressure to 2 psig. Do not operate compressors during the evacuation procedure.

3.05 Charging: After completing the successful evacuation procedure, charge refrigerant directly to the system from the original containers through a filter drier. Charge to the manufacturer's stated conditions of pressure for required temperature. Weigh the refrigerant added and record on the startup report.

3.06 Cleaning: Clean tar and all other soil from housing exterior. Leave ready for Division 7, Caulking Work. Caulk around pipe sleeves.

3.07 Condensate Drain: Pipe trapped copper condensate drain to outside the building or to a point of disposal as shown on the drawings. Pipe shall be full size of unit outlet. Refer to Division-23 section "Insulation" for pipe insulation.

3.08 Startup: Check entire assembly for correctness of installation, alignment, and control sequencing. Start all component parts in proper sequence. Make all adjustments required to insure proper smooth quiet operation.

END OF SECTION 23 81 28

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 23 84 16 - MECHANICAL DEHUMIDIFICATION UNITS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Approval Submittals:

1.3.1 Product Data: Submit manufacturer's technical product data, including dimensions, ratings, electrical characteristics, weight, capacities, materials of construction, and installation instructions.

Dehumidification units

1.4 Test Reports and Verification Submittals:

1.4.1 Submit Startup Report by factory-trained representative.

1.5 O&M Data Submittals: Submit manufacturer's maintenance data including parts lists. Include these data, a copy of approval submittals, product data, and wiring diagrams in O&M manual.

2 PRODUCTS

2.1 Quality Assurance:

2.1.1 Provide units tested by UL, ARL or ETL.

2.1.2 Acceptable Manufacturers: Subject to compliance with requirements provide units by Innovative Dehumidifier Systems, Ultra-Aire, or approved equal.

2.2 General:

2.2.1 Units shall be factory-assembled, wired and tested. All controls shall be factory-adjusted and preset to the design conditions.

2.2.2 In Wall Dehumidifier: Construct of heavy gauge steel formed panels rigidly reinforced and braced. Each unit shall be fully serviceable from the front access panel. Units shall be sealed to minimize leakage. Unit shall be designed to fit within 16” o.c. wall studs. Unit shall operate at 47 dBA or less. Provide epoxy coated coils. Provide automatic control system with build in humidistat behind tamper proof cover. Provide washable air filter, drain connector, drain tube, and control board with built-in safety switch.

2.2.3 Warranty: Provide 24 month warranty for materials and workmanship after the date of shipment.

3 EXECUTION

3.1 Installation: Install in accordance with producer's printed instructions.

3.2 Mount units level and plumb from structure.

3.3 Controls: Set up controls for automatic operation when the room relative humidity exceeds 60%.

3.4 Cleaning: Clean tar and all other soil from housing exterior. Leave ready for Division 7, Caulking Work.

3.5 Condensate Drain: Pipe condensate drain (full size of unit outlet) to nearest hub drain or as shown on the drawings.

END OF SECTION 23 84 16

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 26 05 00 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

The Electrical General Requirements are supplementing and applicable to Division 26 Sections and shall apply to all phases of work specified herein, shown on the Drawings, or required to provide a complete installation of electrical systems. Section 26 is sub-divided for convenience only.

A. This Section includes the following:

1. Job Conditions
2. Regulatory Requirements
3. Electrical equipment coordination and installation.
4. Submittals, Operating and Maintenance instructions and As-built drawings.
5. Common electrical installation requirements.
6. Warranty of work.

1.2 JOB CONDITIONS:

A. Site Inspections: Before submitting proposals, each bidder should visit the site and fully familiarize himself with all job conditions and shall be fully informed as to the extent of his work. No consideration will be given after bid opening date for alleged misunderstanding as to the requirements of work involved in connecting to the utilities or as to requirements of materials to be furnished. The contractor shall contact the utility prior to bid and make appropriate provisions in such bid as required by the utility for the utility's routing and connection.

B. Scheduled Interruptions: Planned interruptions of utilities service, to any facility affected by this contract, shall be carefully planned and approved by Architect at least fourteen (14) days in advance of the requested interruption. The Contractor shall not interrupt services until the Architect has granted specific approval. The request shall indicate services to be affected, date and time of interruption and duration of outage. Request for interruption of service will not be approved until all equipment and materials required for the completion of that particular phase of work are on the job site. The work may have to be scheduled after normal working hours.

C. Accidental Interruptions: All excavation and/or remodeling work required shall be performed with care so as not to interrupt other existing services (water, gas, electrical, sewer, sprinklers, etc.). If accidental utility interruption resulting from work performed by the Contractor occurs, service shall be immediately restored to its original condition without delay, by and at the expense of the Contractor, using skilled workmen of the trade required.

1.3 REGULATORY REQUIREMENTS:

A. Permits, Fees, and Inspections: This Contractor shall secure and pay for all permits, and inspections required on work performed under this section of the Specifications. He shall assume full responsibility for all assessments and taxes necessary for the completion and acceptance of the work. The Owner will arrange for utility power including any impact fees.

B. Applicable Standards and Codes: The electrical installation shall comply with all applicable building codes; local, state, and federal ordinances. In case of a discrepancy among these applicable regulatory codes and ordinances, the most stringent requirement shall govern. The Contractor shall notify the Architect in writing of any such discrepancy. Should the Contractor perform any work that does not comply with the applicable regulatory codes and ordinances he shall bear all cost arising in correcting the deficiencies. Application standards and codes shall include all local ordinances, all state laws, and the applicable requirements of the following:

1. American National Standards Institute - ANSI
2. National Electrical Manufacturer's Association - NEMA
3. National Fire Protection Association – NFPA (latest editions)
4. The National Electric Code – NEC – NFPA 70, 2017
5. The Life Safety Code – NFPA 101, 2018
6. The National Fire Alarm Code – NFPA 72, 2019
7. Florida Building Code, 2020 Edition
8. Underwriters' Laboratories, Inc. – UL

C. Drawings and Specifications: The drawings and these specifications are complementary each to the other. What is called for by one shall be as binding as if called for by both. Omissions from the drawings and specifications of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such work. In any case of discrepancy in the figures or catalog numbers, the matter shall be submitted to the Architect, who shall promptly make a determination in writing. Any adjustment by the Contractor shall be at the Contractor's own risk and expense. Electrical drawings are diagrammatic only. Do not scale these drawings. All equipment shall be installed in accordance with manufacturer's recommendations and any conflicting data shall be verified before bidding.

D. The Contractor shall after completion of the work, furnish the Architect a certificate of final inspection and approval from the applicable local inspection department. The Contractor shall also make necessary changes to plans and specifications to meet code standards at no additional cost to the Owner.

1.4 CONNECTION TO EXISTING UTILITIES:

A. All utility work shall be coordinated with and approved by the local providing utility. Permission for all utility outages shall be requested a minimum of fourteen (14) days in advance, unless an emergency arises. Explicit detail shall be shown for all connections to existing utilities. The applicable utility company must approve both the location and the method of the proposed connection.

B. The contractor coordinate procedure to and shall pay for all electric energy consumption during construction as part of the project.

C. The contractor shall include the electric utility connection fee in the bid unless specifically directed by Owner not to do so. If, prior to bid, the electric utility connection fee is unknown, the Contractor shall include $25,000 as a line item in the bid for each service. Once the utility connection fee is known, if the utility connection fee is less than $25,000, the balance shall be removed from the Contractor's total contract price.

1.5 COOPERATION:

A. Interfacing with Other Crafts: It shall be the responsibility of the Contractor to cooperate and coordinate with all other crafts working on this project. This Contractor shall do all cutting, trenching, backfill and structural removals to permit entry of the electrical system components. The General Contractor shall do all patching and finishing.

B. Equipment Furnished Under Other Sections: This Contractor shall furnish and install, complete electrical roughing-in and connections to all equipment furnished under other sections and indicate on drawings. This includes all outlets as shown on mechanical and electrical drawings. All such equipment shall be set in place as work of other sections.

C. Heating and Air Conditioning:

1. The Contractor shall furnish all branch circuit wiring to motors and control panels or centers including disconnects, receptacles, switches, and appurtenances to which the system at the units may be connected, to provide a complete system of wiring for power. Control equipment and control circuit wiring is specified in the Mechanical Section.

2. Control devices to be included in the branch circuit, except those furnished integrals with the equipment, will be delivered by the Heating and Air Conditioning Contractor and installed by the Electrical Contractor.

1.6 WORKMANSHIP:

All work shall be executed in a neat and substantial manner by skilled workman, well qualified, and regularly engaged in the type of work required. Substandard work shall be **removed and replaced by the Contractor at no cost to the Owner.**

1.7 APPROVAL OF MATERIALS AND EQUIPMENT:

Prior-Submittals: The Contractor shall base his proposal on the materials specified herein and on the drawings. Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of material and equipment required for this installation and is not intended to exclude products equal in quality and similar design. The Specifying Engineer reserves the sole right to decide the equality of materials proposed for use in lieu of these specified. It shall be the Contractor's responsibility to furnish the information and data sufficient to establish the quality and utility of the items in question, including furnishing of samples if required. If other equipment manufacturers determine that their equipment will fit in the space and meet the recommended clearances, suit all job conditions, equal or exceed the quality of the specified items, then a request may be made in writing to the Specifying Engineer at least ten (10) business days prior to bid date for permission to be included in the approved equipment list. All data required for evaluation shall accompany the above letter. The Specifying Engineer offers two submittal reviews, if these are unacceptable, only an "as-specified" submittal will be accepted. In addition, all value engineering alternates should only be submitted when directly requested by the owner and must

be noted specifically as “VE” alternates to the items specified in the construction documents. A letter from the owner directing the VE effort is strongly encouraged as an accompaniment to any VE submittal.

A. Submittals:

1. Submittals: The Contractor shall submit a list of equipment proposed for installation. Catalog data and shop drawings on all proposed systems and their components shall be submitted. Where substitutions alter the design or space requirements, the Contractor shall defray all items of cost for the revised design and construction including costs to all allied trades involved. Provide six (6) copies of submittals and shop drawings as a minimum unless the General Conditions requires a greater number of copies. In lieu of paper copies, the Contractor may submit the submittals in PDF format.
   a. Submittals Schedule: Submittals shall be submitted within thirty (30) days after the contract is awarded. It is not the responsibility of the Engineer to expedite the review of submittals if the contractor has not adequately prepared the submittals in a time efficient manner. The contractor bears all the responsibility for the added time requirements of resubmittals.
   b. Identification: Place a permanent label or title block on each submittal for identification. Each major section of submittals such as power equipment, lighting equipment, fire alarm, etc., shall be secured together in a booklet or stapled with a covering index. The different parts of the submittal shall describe which Specification Section it is referenced. The covering index shall list the following information:
      1) Project name and date
      2) Name, address, and phone number of General contractor and project manager.
      3) Name, address, and phone number of Sub-contractor and project manager.
      4) Supplier of equipment with phone number and person responsible for this project.
      5) Index of each item covered in submittal and model number.
      6) Any deviation from contract documents shall be specifically noted on submittal cover index and specifically identified with highlighting, encircling, or boldly on specific submittal sheet.
   c. The submittal shall not be in individual parts per each Specification Section but be combined as a part of a major section such as power equipment, lighting equipment, fire alarm, methods, etc.
   d. Resubmittals: The Specifying Engineer will participate in two resubmittal reviews. After the second resubmittal review, the Engineer shall not review the submittal until the Contractor provides $1,000 to the Engineer to perform each additional required resubmittal review. Make resubmittals in same form and number of copies as initial submittal.
      1) Include previous submittal review comments.
      2) For each item being resubmitted, include previous review comment and explain how resubmitted item meets the criteria of the previous review comment.

2. Electrical and Mechanical/Plumbing/Fire Protection Equipment Coordination:

   The electrical power equipment submittals shall be accompanied by a letter verifying coordination of electrical services for all mechanical, plumbing, and fire

protection equipment requiring power. The letter shall follow the format listed below.

To: _____
(General Contractor)

Re: _____
(Project name and location)

We the undersigned subcontractors certify that we have coordinated the electrical requirements for mechanical, plumbing, and fire protection sprinkler equipment as evidenced by the coordination chart listed herein.

Item	Load Full Load Amps	1 Phase or 3 Phase	Number of Electrical Connections	Maximum Overcurrent Protection	Minimum Overcurrent Protection	Breaker Proposed	Circuit Proposed

The above list details all required electrical connections for mechanical equipment.

Signed: _____

For: _____
Mechanical Subcontractor

The above list details all required electrical connections for plumbing equipment.

Signed: _____

For: _____
Plumbing Subcontractor

The above list details all required electrical and fire alarm connections for fire protection equipment.

Signed: _____

For: _____
Fire Protection Sprinkler Subcontractor

The above list of equipment has been reviewed and the required connections are being provided. (Any exceptions or request for direction shall be listed here)

Signed: _____

For: _____

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protection: Take necessary precautions to protect all material, equipment, apparatus and work from damage. Failure to do so to the satisfaction of the Architect will be sufficient cause for the rejection of the material, equipment or work in question. Contractor is responsible for the safety and good condition of the materials installed until final acceptance by the owner.

B. Cleaning: Conduit openings shall be capped or plugged during installation. Fixtures and equipment shall be tightly covered and protected against dirt, moisture, chemical and mechanical injury. At the completion of the work the fixtures, material and equipment shall be thoroughly cleaned and delivered in condition satisfactory to the Architect.

1.9 TESTING AND BALANCING:

Make tests that may be required by the Owner or the Architect in connection with the operation of the electrical system in the buildings. Balance all single-phase loads connected to all panelboards in the buildings to insure approximate equal divisions of these loads on the main secondary power supply serving the buildings. All tests shall be made in accordance with the latest standards of the IEEE and the NEC. The installation shall be tested as defined in the 26 specifications. Contractor shall perform circuit continuity and operational tests on all equipment furnished or connected by Contractor. The tests shall be made in the presence of the Architect or his representative. The Contractor shall notify the Architect at least twenty-four (24) hours in advance of tests. The Contractor shall provide all testing equipment and all costs shall be borne by him. Written reports shall be made of all tests and shall be made available at the Pre-Final Inspection**.** All faults shall be corrected immediately.

A. A letter shall be written giving the following:

1. Measured amps on each phase of each panel.
2. Resistance to ground of each new grounding electrode.
3. Measured voltage phase to phase and phase to neutral at each panel.
4. Ground continuity and polarity instrument used.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS/AS BUILT DRAWINGS:

A. Four (4) complete sets of instructions containing the manufacturer's Operating and Maintenance (O&M) instructions for each piece of equipment shall be furnished to the Owner. Each set shall be permanently bound and shall have a hard cover. One complete set shall be furnished at the time that the test procedure is submitted, and remaining sets shall be furnished before the Contract is completed. Flysheets shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8-1/2" by 11" with large sheets of Drawings folded in. The instructions shall include information for major pieces of equipment and systems. In addition, a CD shall be provided to the Owner with the O&M Manuals and Drawings contained therein.

B. Upon completion of the work and at the time designated, the services of one project engineer shall be provided by the Contractor to instruct the representative of the Owner in the operation and maintenance of the systems.

C. This Contractor shall provide as-built Drawings at the completion of the job. Drawings shall show all significant changes in equipment, wiring, routing, location, etc. All underground conduit routing shall be accurately indicated with locations dimensioned. As-built drawings shall be submitted for review as red-lined on a field hard copy (Digitally edited PDF documents are also acceptable).

D. All signals, communications, data, control, dimming systems, etc. shall be included in the As-Built drawings. Where electrical drawings contain a large number of items that prevent easy discernment of the As-Built system, enlarged details or other graphic methods shall be used to clarify the identification required for As-Builts usage.

E. As-Built drawings shall include the following information:

1. Stub-out locations dimensioned from permanent building lines.
2. Routing of all main feeders and identified as under slab, in slab, above ceiling, etc. also for lighting and power branch circuits the number of conductors shall be included, and for feeders and motor branch circuits the number, size, and insulation of conductors shall be included.
3. Corrected panel board and equipment schedules.
4. Corrected circuit numbers as they appear on the panel board directories.
5. Corrected motor horsepower and full load amperes.
6. Location of major distribution open junction boxes with 2” conduit and over.
7. Location of all underground raceways or duct banks dimensioned from easily identified points with depth indicated from BFG (below finished grade) and by elevation in feet.

1.11 GUARANTEE AND SERVICE:

A. Upon completion of all tests and acceptance, the Contractor shall furnish the Owner a written guarantee covering the electrical work done for a period of one (1) year from date of acceptance. Guarantee includes equipment capacity and performance ratings specified without excessive noise levels. Upon notice from the Architect or the Owner, the Contractor shall, during the guarantee period, rectify and replace any defective material or workmanship and repair any damage caused thereby without additional cost.

PART 2 - EXECUTION

2.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1-2015.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Aluminum building wire rated 600 V or less.
3. Fire-alarm wire and cable.
4. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

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

1. Alpha Wire Company.
2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation – All types may not be indicated below, coordinate with Drawings and intended uses:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
5. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Allowed Use Locations: Aluminum conductors may only be used on feeder or distribution circuits larger than 100A. The Drawings typically indicate all conductor sizes in copper. The contractor shall provide a cross reference table for engineer approval prior to any conductor to be substituted with an aluminum conductor.

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

1. Alpha Wire Company.
2. General Cable Technologies Corporation.
3. Okonite Company (The).
4. Southwire Company.

D. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

E. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

F. Conductor Insulation – All types may not be indicated below, coordinate with Drawings and intended uses:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type THHN and Type THWN-2: Comply with UL 83.
4. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
5. Type XHHW-2: Comply with UL 44.

2.3 FIRE-ALARM WIRE AND CABLE

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

1. General Cable Technologies Corporation.
2. Okonite Company (The).
3. Southwire Company.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.4 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 3 AWG; copper or aluminum for feeders No. 3 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Walls and Partitions: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway or Type RHW-2/USE-2 if exterior located.

G. Exposed Branch Circuits, Including in Crawlspaces: Type XHHW-2, single conductors in raceway.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according as required by other Specification sections."

3.4 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.

B. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

E. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

D. Prior to conduit/conductor routing to outlets, contractor shall request final verification of locations. Outlets shall be allowed to be moved 10 feet prior to installation with no cost change.

E. Comply with requirements in accompanying Section on Fire Alarm Systems for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to requirements in accompanying Sections in this book of Specifications.

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in accompanying Sections in this book of Specifications.

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to requirements in accompanying Sections in this book of Specifications.

END OF SECTION 26 05 19

SECTION 26 05 23 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balanced twisted pair cabling hardware.
2. RS-485 cabling.
3. Low-voltage control cabling.
4. Control-circuit conductors.

1.2 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inches or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

E. RoHS compliant.

2.2 BALANCED TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.

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

1. AMP NETCONNECT; a TE Connectivity Ltd. company.
2. Belden CDT Networking Division/NORDX.
3. General Cable; General Cable Corporation.
4. Hubbell Premise Wiring.
5. Siemon Co. (The).
6. Superior Essex Inc.

C. General Requirements for Balanced Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 5e and/or Category 6 as applicable to product used.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Connecting Blocks: 110-style IDC for Category 5e or Category 6 as applicable Provide blocks for the number of cables terminated on the block, plus 20 percent spare, integral with connector bodies, including plugs and jacks where indicated.

E. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 12, 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch equipment racks or on wall-mountable independent of an equipment rack.

F. Patch Cords: Factory-made, four-pair cables in lengths necessary to connect equipment or as indicated on the Drawings; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant and color coded boots to ensure performance. Patch cords shall have latch guards to protect against snagging.

G. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
3. Marked to indicate transmission performance.

H. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standards.

    a. Category 5e, unshielded balanced twisted pair cable shall comply with IEC 60603-7-2.
    b. Category 5e, shielded balanced twisted pair cable shall comply with IEC 60603-7-3.
    c. Category 6, unshielded balanced twisted pair cable shall comply with IEC 60603-7-4.
    d. Category 6, shielded balanced twisted pair cable shall comply with IEC 60603-7.5.

4. Marked to indicate transmission performance.

I. Faceplate:

1. Port quantity as indicated on the Drawings, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Drawings and Architect
3. Metal Faceplate: Stainless steel, complying with requirements in "Wiring Devices."
4. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.

    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

J. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.3 TWIN-AXIAL DATA HIGHWAY CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, One pair or as noted on Drawings, No. 18 AWG, stranded (7x32) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.

5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.4 RS-232 CABLE

A. PVC-Jacketed, TIA 232-F:

1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. PVC jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. NFPA 70 Type: Type CM.
7. Flame Resistance: Comply with UL 1581.

B. Plenum-Type, TIA 232-F:

1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.5 RS-485 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.6 LOW-VOLTAGE CONTROL CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.7 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

B. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.8 FIRE-ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.9 SOURCE QUALITY CONTROL

A. Factory test balanced twisted pair cables according to TIA-568-C.2.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
2. Flexible metal conduit shall not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 4 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lay on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 18 inches in diameter.

3.3 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.5 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For low-voltage control wiring and cabling, comply with requirements "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Comply with requirements for identification specified in "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 05 23

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Ground bonding common with lightning protection system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

a. Test wells.
b. Ground rods.
c. Grounding arrangements and connections for separately derived systems.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

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

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO; a brand of nVent.
3. Galvan Industries, Inc.; Electrical Products Division, LLC.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.
5. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

D. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

E. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

F. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

G. Straps: Solid copper, copper lugs. Rated for 600 A.

H. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

I. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

   a. Material: Die-cast zinc alloy.
   b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.
3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.

1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.

4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Conduit and cable support devices.
4. Support for conductors in vertical conduit.
5. Structural steel for fabricated supports and restraints.
6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
7. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

    a. Slotted support systems, hardware, and accessories.
    b. Clamps.
    c. Hangers.
    d. Sockets.
    e. Eye nuts.
    f. Fasteners.
    g. Anchors.
    h. Saddles.
    i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, undefined:

    a. Allied Tube & Conduit; a part of Atkore International.
    b. B-line, an Eaton business.
    c. Thomas & Betts Corporation; A Member of the ABB Group.
    d. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, undefined:

    a. Cooper Industries, Inc.
    b. Thomas & Betts Corporation; A Member of the ABB Group.
    c. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channel Material: 6063-T5 aluminum alloy.
4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
5. Channel Width: Selected for applicable load criteria.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, undefined:
        1) Hilti, Inc.
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, undefined:
        1) B-line, an Eaton business.
        2) Hilti, Inc.
        3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        4) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F 3125M, Grade A325 .
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

    1) NECA 1.
    2) NECA 101
    3) NECA 102.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 26 05 29

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. "Penetration Firestopping" for firestopping at conduit and box entrances.
2. "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

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

    a. Allied Tube & Conduit; a part of Atkore International.
    b. O-Z/Gedney; a brand of Emerson Industrial Automation.
    c. Southwire Company.
    d. Thomas & Betts Corporation; A Member of the ABB Group.
    e. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

    a. Comply with NEMA RN 1.
    b. Coating Thickness: 0.040 inch, minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

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

    a. Allied Tube & Conduit; a part of Atkore International.
    b. O-Z/Gedney; a brand of Emerson Industrial Automation.
    c. Southwire Company.
    d. Thomas & Betts Corporation; A Member of the ABB Group.
    e. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

    a. Material: Steel.
    b. Type: Setscrew or compression.

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

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

    a. RACO; Hubbell.
    b. Thomas & Betts Corporation; A Member of the ABB Group.
    c. United Fiberglass.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:

    a. Comply with NEMA TC 14.
    b. Comply with UL 2515 for aboveground raceways.
    c. Comply with UL 2420 for belowground raceways.

4. ENT: Comply with NEMA TC 13 and UL 1653.
5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
6. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:

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

    a. RACO; Hubbell.
    b. Thomas & Betts Corporation; A Member of the ABB Group.
    c. United Fiberglass.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

    a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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

1. B-line, an Eaton business.
2. Hoffman; a brand of nVent.
3. MonoSystems, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

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

1. Crouse-Hinds, an Eaton business.
2. EGS/Appleton Electric.
3. Hoffman; a brand of nVent.
4. Hubbell Incorporated.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. RACO; Hubbell.
7. Thomas & Betts Corporation; A Member of the ABB Group.
8. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Nonmetallic Floor Boxes: Nonadjustable, rectangular or round, as indicated on Drawings.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1 Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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

a. Armorcast Products Company.
b. Oldcastle Enclosure Solutions.
c. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC.".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC IMC.
2. Concealed Conduit, Aboveground: GRC IMC EMT RNC, Type EPC-40-PVC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: IMC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to IMC before rising above floor.

M. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway

section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Z. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Set metal floor boxes level and flush with finished floor surface.

II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes with bottom below frost line

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Precast concrete handholes.
6. Polymer concrete handholes and boxes with polymer concrete cover.
7. Fiberglass handholes and boxes with polymer concrete cover.
8. Fiberglass handholes and boxes.
9. High-density plastic boxes.
10. Utility structure accessories.

1.3 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for handholes and boxes.
4. Include underground-line warning tape.
5. Include warning planks.

B. Shop Drawings:

1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes.
c. Include cover design.
d. Include grounding details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For duct and duct bank. Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C858.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect and Construction Manager no fewer than fourteen days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's, Construction Manager's, and Owner's written permission.

B. Ground Water: Assume ground-water level is 36 inches below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

C. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 FLEXIBLE NONMETALLIC DUCTS

A. HDPE Duct: Type EPEC-40 HDPE, complying with NEMA TC 7 and UL 651A.

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.4 DUCT ACCESSORIES

A. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.5 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

B. Comply with ASTM C858 for design and manufacturing processes.

C. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.

1. Cover Hinges: Concealed, with hold-open ratchet assembly.
2. Cover Handle: Recessed.

D. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

E. Cover Legend: Molded lettering, "ELECTRIC" or as indicated for each service.

F. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.

G. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 HIGH-DENSITY PLASTIC BOXES

A. Description: Injection molded of HDPE or copolymer-polypropylene. Cover shall be made of plastic.

B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.

C. Color: Green.

D. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

E. Cover Legend: Molded lettering, "ELECTRIC" or as indicated for each service.

F. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.

G. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.

H. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.7 SOURCE QUALITY CONTROL

A. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify

Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-10 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: High-density plastic, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: High-density plastic, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: High-density plastic, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Replace area after construction vehicle traffic in immediate area is complete.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

E. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
3. Depth: Install top of duct at least 36 inches (900 mm) below finished grade unless otherwise indicated.
4. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately

6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

6. Install duct with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and communications duct.
7. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.

    a. Stub-ups shall be minimum 4 inches (100 mm)above finished floor and no less than 3 inches (75 mm)from conduit side to edge of slab.

F. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all duct and duct banks. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.4 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

A. Precast Concrete Handhole Installation:

1. Comply with ASTM C891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

C. Waterproofing: Apply waterproofing to exterior surfaces of handholes after concrete has cured at least three days. After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars.

D. Dampproofing: Apply dampproofing to exterior surfaces of handholes after concrete has cured at least three days. After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars.

3.5 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

E. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.6 GROUNDING

A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
2. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Prepare test and inspection reports.

END OF SECTION 26 05 43

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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

    a. Advance Products & Systems, Inc.
    b. Metraflex Company (The).
    c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Emerson
    b. Innerlynx, Eaton Crouse-Hinds, a Cooper Industries Company
    c. Link-Seal, GPT an EnPro Industries Company
    d. Metraflex

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have a VOC content of 50 g/L or less.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 26 05 44

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

C. Comply with ANSI Z535.4 for safety signs and labels.

D. Comply with NFPA 70E and "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an white field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.

2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Color for Neutral: White.

5. Color for Equipment Grounds: Bare copper, Green, or Green with a yellow stripe.

C. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES ."

E. Equipment Identification Labels:

1. White letters on a Black field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3.5-mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

    a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
    c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

3. Description:

    a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, compounded for direct-burial service.
    b. Width: 3 inches.
    c. Overall Thickness: 5 mils.
    d. Foil Core Thickness: 0.35 mil.
    e. Weight: 28 lb/1000 sq. ft.
    f. Tensile according to ASTM D882: 70 lbf and 4600 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

    a. For signs up to 20 sq. in., minimum 1/16 inch thick.
    b. For signs larger than 20 sq. in., 1/8 inch thick.
    c. Engraved legend with black letters on white face
    d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and/or any emergency operations.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER"
2. "POWER"
3. “LIFE SAFETY”

L. Vinyl Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

N. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

O. Self-Adhesive Labels:

1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

X. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER"
2. "POWER"
3. “LIFE SAFETY”

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Workspace Indication: Apply floor marking tape and stencil] to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

O. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and other emergency operations.

P. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 26 05 53

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

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

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

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

1. EasyPower.
2. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in "Coordination Studies."

G. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.

    a. Arc-flash boundary.
    b. Restricted approach boundary.
    c. Limited approach boundary.

4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

C. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

D. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

E. Calculate the limited, restricted, and prohibited approach boundaries for each location.

F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

H. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance or available short circuit current at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Voltage level at each bus.

6. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
11. Motor horsepower and NEMA MG 1 code letter designation.
12. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Medium voltage transformers
6. Low voltage transformers. Exclude transformers with high voltage side 240 V or less and less than 125 kVA.
7. Panelboard and safety switch over 250 V.
8. Applicable panelboard and safety switch under 250 V.

C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

END OF SECTION 26 05 73.19

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.

2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. This section specifies the unique responsibilities that are a part of, or are related to the commissioning process for the electrical systems. Electrical systems include those listed in Division 01 Section "General Commissioning Requirements" as being commissioned. All statements are the responsibility of the Subcontractor, unless specifically stated otherwise.

2. Electrical testing specified for systems not listed as formally commissioned are not under the commissioning umbrella and are not governed by this section.

3. Electrical Systems Commissioning consists of static checks of component and system installations and actual testing of equipment conditions and functions.

4. The Commissioning Authority will review and approve, prior to use, all test procedures and forms used and will witness a varying fraction of the initial checks and testing performed by the Subcontractor. The Commissioning Authority will review the completed check and test documentation of the Subcontractor of all checks and tests.

5. Electrical testing requirements are found in various sections in Division 01 and in Division 26 (Division 01 Section "General Commissioning Requirements" and this section). It is not the intent of the commissioning process or these specifications to duplicate efforts or to require the Subcontractor to perform any check or test twice. Checks and testing by the Subcontractor are expected to occur once in the normal sequence of installation and checkout, if appropriate coordination has occurred allowing the Commissioning Authority to witness installations and initial testing. Identical electrical checks and testing requirements in both Division 01 and Division 26 are referring to the same event.

6. The test requirements listed in this section do not release the Subcontractor from the obligation to perform all other appropriate, industry standard, manufacturer-recommended or code-required checks and tests.

7. Testing Participants. The work of this section shall be performed by parties identified in the Check and Testing Responsibility Table--a supplement to Division 01 Section "General Commissioning Requirements". Static checks and testing shall be fully documented according to provisions in Division 01 Section "General Commissioning Requirements".

C. Related Sections:

1. Division 01 Section "General Requirements."

2. Division 01 Section "Special Procedures."

3. Division 01 Section "General Commissioning Requirements".

1.2 SUBMITTALS

A. Submit under provisions of Divisions 01 Section "General Requirements" and "Special Procedures."

1.3 QUALITY ASSURANCE

A. Qualifications:

1. The CTC (Certified Testing Company) performing the work of this section shall be qualified to test electrical equipment and is a NETA (National Electrical Testing Association)-certified testing agency. The CTC shall not be associated with the manufacturer of equipment or systems under test.

B. Test Equipment:

1. The Subcontractor shall provide all test equipment necessary to fulfill the checks and testing requirements. Test equipment shall have been calibrated within one (1) year of its use on the project.

2. Refer to Division 01 Section "General Commissioning Requirements" for additional requirements.

PART 2 - EXECUTION

2.1 SUBMITTALS

A. Sixty (60) days before any testing is conducted, submit an overall testing plan and schedule for electrical systems that lists the equipment, modes to be tested, dates of testing and parties conducting the tests. Put these tests into the master construction schedule. Keep this plan and schedule updated.

B. Additional submittal requirements relative to commissioning are found in this Section and in Division 01 Section "General Commissioning Requirements" and Division 01 Section "General Requirements."

2.2 COMMON RESPONSIBILITIES

A. The following are responsibilities applicable to all electrical systems being commissioned.

B. The general commissioning requirements and coordination are detailed in Division 01 Section "General Commissioning Requirements" and apply to electrical systems. The Subcontractor shall be familiar with all parts of Division 01 Section "General Commissioning Requirements" and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

C. The work of this Section shall be performed by a CTC (Certified Testing Company, Electrical), by the EC (Electrical Subcontractor), or the MSR (Manufacturer's Service Representative). The Commissioning Authority has some testing responsibilities for some equipment. The specified checks and static tests are conducted by any of the above listed parties, but the tests requiring measurements or special tools or skills are generally conducted only by the CTC. The Check and Testing Responsibility Table, included as a supplement to Division 01 Section "General Commissioning Requirements" provides specific allocation of checklist oversight and testing responsibilities. The CTC, EC, and MSR shall document all checks and testing on check and test procedure forms submitted to and approved by the Commissioning Authority prior to testing.

D. The Subcontractor shall notify the CA ahead of time when commissioning activities not yet performed or not yet scheduled will delay construction. The Subcontractor shall be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.

E. The Subcontractor shall respond to notices of issues identified during the commissioning process, making required corrections or clarifications and returning prompt notification to the Commissioning Authority according to the process given in Division 01 Section "General Commissioning Requirements".

F. When completion of a task or other issue has been identified as holding up any commissioning process, particularly functional testing, the Subcontractor shall, within two (2) days of notification of the issue, notify the Commissioning Authority in writing providing an expected date of completion. The Subcontractor shall notify the Commissioning Authority in writing within one day of completion. It is not the responsibility of the Commissioning Authority to obtain this status information through meeting attendance, asking questions or field observation

G. Construction Checklists. The Commissioning Authority or Subcontractor shall develop checklists as noted in the list of commissioned systems in Division 01 Section "General Commissioning Requirements", following the process described in Division 01 Section "General Commissioning Requirements" and in this Section. At a minimum, for a given piece of equipment, checks from the inspection checklists in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems shall be included in the electrical checklists. The Subcontractor shall execute and document all checks.

H. Check and testing procedure and startup plan development and execution responsibilities are described in the Check and Testing Responsibility Table in the supplements to Division 01 Section "General Commissioning Requirements".

I. The Subcontractor shall review design documents, shop drawings and O&M manuals and manufacturer recommended installation and testing procedures of each system installation.

J. The Subcontractor shall monitor installation to ensure the equipment, configuration and quality of construction meets the design requirements, approved submittals and shop drawings.

K. The Subcontractor shall develop test procedures and forms and execute and document testing according to the requirements of this Section, Division 01 Section "General Commissioning Requirements" and other specification sections containing testing requirements.

L. Tests of energized equipment shall be conducted when the equipment is operating at its normal capacity. This may require some tests to be conducted after occupancy.

M. Training and Orientation. The Subcontractor shall follow the facility staff orientation and training requirements as described in Division 01 Section "Demonstration and Training" and other applicable technical sections.

N. Operation And Maintenance (O&M) Manuals. Refer to Division 01 Section "General Commissioning Requirements" and Division 01 Section "General Requirements" for requirements for O&M manuals.

PART 3 - EQUIPMENT-SPECIFIC VERIFICATION AND TESTING REQUIREMENTS

3.1 SUMMARY

A. This Part specifies the check and testing requirements for electrical components and systems. From these requirements, the Commissioning Authority or Subcontractor will develop detailed procedures and forms. The general testing process, requirements and test method definitions are described in Division 01 Section "General Commissioning Requirements".

3.2 CHECKS AND TESTS

A. Checks are intended to begin upon completion of a component or equipment installation. Testing generally occurs later when systems are energized or nearing that point. Beginning system testing before full completion, does not relieve the Subcontractor from fully completing the system as soon as possible, including all construction checklists and may require retesting portions of the system once all components are fully functioning.

B. Refer to Division 01 Section "General Commissioning Requirements" for specific details on non-conformance issues relating to construction checklists and tests. Refer to Division 01 Section "General Commissioning Requirements", for common requirements of deferred testing and to articles in this Section.

C. The check and test procedures and record forms shall contain the following:

1. The Subcontractors executing the checks or tests.

2. A list of the integral components being inspected and tested, equipment tag numbers, manufacturer, model number, pertinent performance information / rating data.

3. Test equipment used.

4. Construction checklists associated with the components, if any.

5. Any special required conditions of the check or test for each procedure.

6. Items, conditions or functions to be inspected, verified or tested, the checks and testing method given and a place provided with results recorded.

7. Acceptance criteria (or reference by specific table where the acceptance criteria is found).

8. For each procedure, list the technician performing check or test and company, witnesses of the tests and dates of tests.

9. Sampling strategies used.

D. The test procedures for dynamic equipment like lighting controls, emergency generator or fire alarm shall contain more step-by-step procedures with expected responses similar to the sample test provided as a supplement to Division 01 Section "General Commissioning Requirements". The test procedures and forms for more static components like panel boards, switch gear, circuit breakers, transformers, etc., can be more checklist-like in format. For each piece of equipment, checks and test procedures and their documentation record forms may be different documents or combined in the same document, but checks and tests should be grouped.

E. At the Commissioning Authority's discretion, if large numbers or repeated deficiencies are encountered, the Subcontractor shall test and troubleshoot all remaining systems at issue on their own before commissioning with the Commissioning Authority will resume.

F. Sampling for Identical Units. When there are a number of identical units, at the Commissioning Authority’s discretion, some or all procedures of a test for a piece of equipment or assembly may be omitted when these same tests on other pieces of identical equipment or assemblies were conducted without deficiency.

3.3 EQUIPMENT-SPECIFIC TESTING REQUIREMENTS

A. The following paragraphs define the testing requirements for each type of system or feature that is a part of the project. The Commissioning Authority shall use this information to develop specific testing procedures for each of the systems to be commissioned. The Subcontractor shall be responsible for support, execution and coordination of these tests as described in the project specifications including intersystem tests and interlocks with systems in Divisions other than Division 26.

B. Common Testing Requirements

1. The following requirements apply to all electrical systems and features that are to be commissioned when referenced below. Tests shall:

a. Verify functionality and compliance with the design intent for each individual sequence module in the sequences of operation. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Test every step in every written sequence and other significant modes, sequences and operational features not mentioned in written sequences; including startup, normal operation, shutdown, scheduled on and off, unoccupied and manual modes, safeties, alarms, over-rides, lockouts and power failure.

b. Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.

c. Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.

d. Verify shut down and restart capabilities both for scheduled and unscheduled events (e.g. power failure recovery and normal scheduled start/stop).

e. When applicable, demonstrate a full cycle from off to on and no load to full load and then to no load and off.

f. Verify time of day schedules and setpoints.

g. Verify all energy saving control strategies.

h. Verify that monitoring system graphics are representative of the systems and that all points and control elements are in the same location on the graphic as they are in the field.

i. Verify operator control of all commandable control system points including proper security level access.

j. When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA test procedures shall be part of the testing requirements of this specification. Additional testing procedures may be listed in this specification.

k. Common Acceptance Criteria

2. The following common acceptance criteria apply to all mechanical equipment, assemblies and features:

a. For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequences of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications. Verify that equipment operates within tolerances specified in: governing codes, acceptance criteria contained in the construction documents, manufacturer's literature and according to good operating practice.

b. Systems shall accomplish their intended function and performance.

c. All safety trips shall require a manual reset to allow a system restart.

d. Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.

e. Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass, etc.).

f. Other acceptance criteria is given in the equipment testing requirements articles or referenced standards.

g. Additional acceptance criteria will be developed by the Commissioning Authority when detailed test procedures are developed.

h. When testing procedures for commissioned equipment are listed in NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems the NETA performance criteria shall apply.

C. Equipment-Specific Testing Requirements:

1. Scheduled Lighting Controls.

a. Apply the applicable common testing requirements and acceptance criteria.

b. Test Methods. Utilize active testing, and trending when available. If able to trend, trend all zones over a week period and follow the trending guidelines in Division 23 Section "Commissioning of HVAC".

c. Sampling Strategy. Manually test 20 percent of the zones or at least four. If more than 10 percent or two zones fail, test another 10 percent sample. If the second sample fails the Subcontractor shall document retesting on all zones on their own using a Commissioning Authority approved form.

2. Occupancy/Vacancy Sensor Lighting Controls.

a. Apply applicable common testing requirements and acceptance criteria. Test all units functions, including sensor sensitivity and time-to-OFF functions and ensure that sensor location is proper and won't be tripped inadvertently by other occupants and movements outdoors, etc.

D. Test Methods. Utilize active test methods.

a. Sampling Strategy. Test 10 percent of the sensors or six, whichever is greater. If more than 10 percent or two sensors fail, test another 10 percent sample. If the second sample fails the Subcontractor shall document retesting on all units on their own using a Commissioning Authority approved form.

b. Additional Acceptance Criteria. Reasonable sensitivity, no inadvertent trips, lights go off within 15 seconds of design.

1. Emergency Generator System

    a. Apply applicable common testing requirements and acceptance criteria.

    b. Test according to NETA 7.22.1 and NFPA 110 5.13 and per Division 01 Section "Special Procedures."

    c. Record all data and results.

    d. Include the following tests:

        1) When in enclosed spaces, verify combustion and ventilation air damper functions and pressure drop of exhaust.

        2) Verify fuel oil system, diesel fuel storage tank, and level and low fuel indication alarms.

        3) Verify all alarms, meters, and auxiliaries and interlocks to the BAS.

    e. Building Test. Under a cold generator condition, provide full utility power interruption under load and cause emergency power service operation. If applicable, include all UPS in this test. Load bank the UPS if necessary during test.

    f. Verify all generator functions

    g. Test auto-transfer switch operation under actual voltage drop, per specification Division 26 Section "Transfer Switches".

    h. Using a power line disturbance monitor, measure the following times: power failure to engine start command, engine start command to engine start (cranking time), engine start to point where generator is at proper volts and frequency and total time from power failure until ATS switches.

    i. Verify system reporting & control monitoring point-to-point

    j. Verify that each circuit and equipment served by emergency power, does power up. Verify all functions of the Emergency Power Response Matrix.

    k. Verify appropriate mechanical system and control system restart functions of all equipment served by the generator.

2. Step Load Tests.

    a. Test at 0 percent, 25 percent, 50 percent and 100 percent of full load. Measure voltage and frequency and record all gaged engine conditions. The test shall consist of running the engine-generator while connected to the resistive load bank for one hour, and then shutting down for 30 minutes.

    b. Test for multiple generator starts.

    c. Verify all operational data and start-up minimum time interval.

d. Verify 2-hour full load run full load bank (building load can serve as part of the load).

e. Verify all generator-running characteristics.

f. Verify battery-charging system.

3. Fire Alarm.

a. Apply applicable common testing requirements and acceptance criteria.

b. Test the fire alarm system according to NFPA 110-1999 7-1 through 7-2, and specification Division 28 Section "Multiplex Addressable Fire Alarm System – Voice Evacuation".

c. Document all test procedures and results. A fire alarms system printout of the test annunciation record is not sufficient documentation.

d. Verify all fire alarm panel functions, alarms and troubles.

e. Verify all functions in the Fire Alarm Response Matrix, including remote communications.

f. Verify resetting of all equipment affected by an alarm.

g. Sampling Strategy. Verify device functions and annunciations per using the approved sampling rate of the authority having jurisdiction and per LBNL.

END OF SECTION 26 08 00

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 26 09 43 - DISTRIBUTED INTELLIGENCE BASED LIGHTING CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Distributed Digital Lighting Control System: System includes
   1. Digital Lighting and Controls

1.2 RELATED SECTIONS

A. Section 26 51 19 – LED Interior Lighting.

B. Section 26 56 19 – LED Exterior Lighting.

C. Section 26 52 13 - Emergency and Exit Lighting.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. NEMA - National Electrical Manufacturers Association

C. FCC emission standards

D. UL - Underwriters Laboratories, Inc. Listings

E. UL 20 - General Use Switches, Plug Load Controls

F. UL 924 - Standard for Emergency Lighting and Power Equipment

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Catalog sheets and specifications.
   2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   3. Storage and handling requirements and recommendations.
   4. Installation instructions.

C. Shop Drawings: Wiring diagrams for the various components of the System specified including:
   1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
   2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on reflected ceiling plans.
   3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
   4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Closeout Submittals:
   1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
   2. Operation and Maintenance Manual:
      a. Include approved Shop Drawings and Product Data.
      b. Include Sequence of Operation, identifying operation for each room or space.
      c. Include manufacturer's maintenance information.
      d. Operation and Maintenance Data: Include detailed information on device programming and setup.
      e. Include startup and test reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:
   1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
   2. Review the specifications for low voltage control wiring and termination.

3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
4. Discuss requirements for integration with other trades

C. Inspect and make notes of job conditions prior to installation:
1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.10 WARRANTY

A. Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

1.11 REMOTE ACCESS AND ENHANCED WARRANTY FOR NETWORKED SYSTEMS

A. Provide Manufacturer's Remote Access and Enhanced Warranty for Networked Lighting Controls as follows:
1. Configure to allow the manufacturer remote access to the lighting control system. Configuration includes at a minimum: cellular modem, antenna for the modem, cellular service contract and any connections required to enable communication to the specified Network Lighting Control system.
2. The Remote Access program will automatically trigger a First Year Enhanced Warranty Agreement that will start once lighting control system startup is complete and accepted by the Owner. During this one year period, the Owners authorized site contact can request the manufacturer to check the system for proper operation, and make any programmable changes desired. Manufacturer shall provide a phone number dedicated to customer calls concerning Remote Accessible systems, and a support organization capable of enabling cellular communication to the system for troubleshooting and making requested changes to the system. Any user attempting to request remote support on the system shall be fully verified by the Remote Operations Center before providing remote support or making any changes to the system. Systems that allow the modem to be always accessible will not be acceptable.

Access must be by a secured VPN connection to the private lighting control network that is completely isolated from the Owner's internal network. Remote access that requires a connection through the Owner's internal network is not acceptable.

3. The Remote Access Program may be continued by the Owner after the first year. However, If the Owner does not continue the enhanced warranty the cellular contract will lapse, and all hardware components, while still remaining property of the manufacturer, will remain in situ so that they can be re-activated at a later time should the Owner desire.
4. The Manufacturer's Remote Access capability shall provide at a minimum the following features:
    a. Ability to provide initial system diagnostics through Lighting Management Control (LMCS) Software to detect fault conditions in hardware or connected devices.
    b. Access to all devices via LMCS Software allowing for programmability of device features. This will include all scheduling of Time of Day Events and programming of individual device parameters to meet Sequence of Operation requirements.
    c. Access to the LMSM Segment Manager browser-based interface (if included on project) to verify it is setup per project documentation, and all functional operations are working properly.
    d. On demand access to manufacturer technical support via a Remote Operations Center that will provide remote troubleshooting, diagnostics, and configuration/programming assistance.
    e. Additional client training and tuning on the Lighting Control System after building occupancy can be performed while remotely connected to the site.
    f. Two (2) additional on-site services by the manufacturer (or certified representative) for the Lighting Control System after building occupancy shall be available for the first 2 years and within a 4-day timeframe.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1) WattStopper, a division of Legrand North America, LLC.
2) nLIGHT, a division of Acuity Brands Inc.

B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

A. System General: Provide Digital Lighting Management System complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the Architect for clarification prior to proceeding.
    1. Space Control Requirements: Provide occupancy/vacancy sensors with

Manual- or Partial-ON functionality as indicated in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.

2. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Occupancy / vacancy sensors shall be provided to turn off all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

B. Equipment Required: Lighting Control and Automation system as defined under this section covers the following equipment.
   1. Digital Lighting Management local network: Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
   2. Digital Room Controllers: Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
   3. Digital Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
   4. Digital Switches: Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches.
   5. Digital Daylighting Sensors: Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
   6. Digital Lighting Management segment network: Linear topology, BACnet MS/TP network (1.5 twisted pair, shielded) to connect multiple local networks for centralized control.
   7. Network Bridge: Provides BACnet MS/TP-compliant digital networked communication between rooms, panels and the Segment Manager or building automation system (BAS) and automatically creates BACnet objects representative of connected devices.
   8. Segment Manager: BACnet MS/TP-based controller with web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
   9. Emergency Lighting Control Unit (ELCU): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building

2.3 DIGITAL LOAD CONTROLLERS

A. Digital Load Controllers: Digital controllers for lighting zones, fixtures and/or plug loads automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting and plug load control requirements. Controllers are simple to install,

and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications. Control units include the following features

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are assigned based on each controller's device ID's from highest to lowest.
4. Device Status LEDs to indicate:
    a. Data transmission
    b. Device has power
    c. Status for each load
    d. Configuration status
5. Quick installation features including:
    a. Standard junction box mounting
    b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
    a. Turn on to 100 percent
    b. Turn off
    c. Turn on to last level
7. Each load be configurable to operate in the following sequences based on occupancy:
    a. Auto-on/Auto-off (Follow on and off)
    b. Manual-on/Auto-off (Follow off only)
8. BACnet object information shall be available for the following objects:
    a. Load status
    b. Schedule state, normal or after-hours
    c. Demand Response enable and disable
    d. Room occupancy status
    e. Total room lighting and plug loads watts
9. UL 2043 plenum rated
10. Manual override and LED indication for each load
11. Zero cross circuitry for each load
12. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
13. Dimming Room Controllers shall share the following features:
    a. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
    b. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
    c. Override button for each load provides the following functions:
        1) Press and release for on/off control
        2) Press and hold for dimming control
    d. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range

to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.

e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.

f. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.

g. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

B. On/Off Room Controllers shall include:
1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load
2. One or two relay configuration
3. Simple 150 mA switching power supply.
4. Three RJ-45 DLM local network ports with integral strain relief and dust cover

C. On/Off/0-10V Dimming KO Mount Room Controllers shall include:
1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 10A (or greater) total load
2. One or two relays configurations
3. Smart 150 mA switching power supply
4. Two RJ-45 DLM local network ports. Provide molded strain relief ring
5. One dimming output per relay
   a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting.

2.4 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
1. Digital calibration and pushbutton configuration for the following variables:
   a. Sensitivity, 0-100 percent in 10 percent increments
   b. Time delay, 1-30 minutes in 1 minute increments
   c. Test mode, Five second time delay
   d. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
   e. Walk-through mode
2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
3. Programmable control functionality including:
   a. Each sensor may be programmed to control specific loads within a local network.
   b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
   c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10

seconds) after turning off.
        d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
        e. Ultrasonic and Passive Infrared
        f. Ultrasonic or Passive Infrared
        g. Ultrasonic only
        h. Passive Infrared only
        i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
    4. One or two RJ-45 port(s) for connection to DLM local network.
    5. Device Status LEDs, which may be disabled for selected applications, including:
        a. PIR detection
        b. Ultrasonic detection
        c. Configuration mode
        d. Load binding
    6. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
    7. Manual override of controlled loads.
    8. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:
    1. Detection state
    2. Occupancy sensor time delay
    3. Occupancy sensor sensitivity, PIR and Ultrasonic

C. Units shall not have any dip switches or potentiometers for field settings

2.5 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
    1. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
    2. Load/Scene Status LED on each switch button with the following characteristics:
        a. Bi-level LED
        b. Dim locator level indicates power to switch
        c. Bright status level indicates that load or scene is active
        d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
    3. Programmable control functionality including:
        a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
        b. Scene patterns may be saved to any button other than dimming rockers.

Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

4. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:
   1. Button state
   2. Switch lock control
   3. Switch lock status

C. Two RJ-45 ports for connection to DLM local network.

D. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.
   1. Individual button function may be configured to Toggle, On only or Off only.
   2. Individual scenes may be locked to prevent unauthorized change.
   3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
   4. Ramp rate may be adjusted for each dimmer switch.
   5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.

2.6 DLM SEGMENT NETWORK

A. Provide a segment network using linear topology, BACnet-based MS/TP subnet to connect DLM local networks (rooms).
   1. Network bridges, relay panels and segment managers shall include terminal blocks, with provisions for separate "in" and "out" terminations, for segment network connections.
   2. Segment network utilizes 1.5 twisted pair, shielded, cable supplied by the lighting control manufacturer. Maximum cable run for each segment is 4,000 feet. Conductor-to-conductor capacitance of the twisted pair shall be less than 30 pf/ft and have a characteristic impedance of 120 Ohms.
   3. Network wire jacket is available in high visibility green, white, or black.
   4. Substitution of manufacturer-supplied cable is not permitted and may void the warranty, if non-approved cable is installed, and if terminations are not completed according to manufacturer's specific requirements.
   5. Network signal integrity requires that each conductor and ground wire be correctly terminated at every connected device.
   6. Segment networks shall be capable of connecting to any of the following: BACnet-compliant BAS (provided by others) directly via MS/TP, or BACnet/IP via an LMSM Unit.

2.7 NETWORK BRIDGE

A. Network bridge module connects a DLM local network to a BACnet-compliant segment network for communication between rooms, relay panels and a segment manager or BAS. Each local network shall include a network bridge component to provide a connection to the local network room devices. Network bridge shall use industry standard BACnet MS/TP network communication and an optically isolated EIA/TIA RS-485 transceiver.

1. Network bridge shall be provided as a separate module connected on the local network through an available RJ-45 port.
2. Network bridge shall automatically create standard BACnet objects for selected DLM devices to allow any BACnet-compliant BAS to include lighting control and power monitoring features as provided by the DLM devices on each local network. BACnet objects will be created for the addition or replacement of any given DLM device for the installed life of the system. Products requiring that an application-specific point database be loaded to create or map BACnet objects are not acceptable. Systems not capable of providing BACnet data for control devices via a dedicated BACnet Device ID and physical MS/TP termination per room are not acceptable. Standard BACnet objects shall be provided as follows:
    a. Read/write the normal or after hours schedule state for the room
    b. Read the detection state of each occupancy sensor
    c. Read the aggregate occupancy state of the room
    d. Read/write the On/Off state of loads
    e. Read/write the dimmed light level of loads
    f. Read the button states of switches
    g. Read total current in amps, and total power in watts through the load controller
    h. Read/write occupancy sensor time delay, PIR sensitivity and ultrasonic sensitivity settings
    i. Activate a preset scene for the room
    j. Read/write daylight sensor fade time and day and night setpoints
    k. Read the current light level, in foot-candles, from interior and exterior photosensors and photocells
    l. Set daylight sensor operating mode
    m. Read/write wall switch lock status
    n. Read watts per square foot for the entire controlled room
    o. Write maximum light level per load for demand response mode
    p. Read/write activation of demand response mode for the room
    q. Activate/restore demand response mode for the room

2.8 SEGMENT MANAGER

A. For networked applications, the Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP traffic via a configurable port (default is 80) or 256 bit AES encrypted SSL TCP/IP traffic via a configurable port (default is 443).

B. Each segment manager shall have integral support for at least three segment networks. Segment networks may alternately be connected to the segment manger via external BACnet-to-IP interface routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment network. Provide the quantity of routers and switches as shown on the Drawings.

C. Operational features of the Segment Manager shall include the following:
    1. Connection to PC or LAN via standard Ethernet TCP/IP via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
    2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser. The Segment Manager shall not require

installation of any lighting control software on an end-user PC.

3. Log in security capable of restricting some users to view-only or other limited operations.
4. Segment Manager shall provide two main sets of interface screens - those used to initially configure the unit (referred to as the config screens), and a those used to allow users to dynamic monitor the performance of their system, and provide a centralized scheduling interface. Capabilities using the Config Screens shall include:
    a. Automatic discovery of DLM devices and relay panels on the segment network(s). Commissioning beyond activation of the discovery function shall not be required to provide communication, monitoring or control of all local networks and lighting control panels.
    b. Allow information for all discovered DLM devices to be imported into the Segment Manager via a single XML based site file from the LMCS Software. Importable information can include text descriptions of every DLM component and individual loads, and automatic creation of room location information and overall structure of DLM network. Info entered into LMCS should not have to be re-entered manually via keystrokes into the Segment Manager
    c. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
    d. Ability to view and modify DLM device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
    e. Provide capabilities for integration with a BAS via BACnet protocol. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the segment manager: room occupancy state; room schedule mode; room switch lock control; individual occupancy sensor state; room lighting power; room plug-load power; load ON/OFF state; load dimming level; panel channel schedule state; panel relay state; and Segment Manager Group schedule state control. Any of above items shall be capable of being moved into an "Export Table" that will provide any integrator with only the data they need, and by using the Export Table effectively create a firewall between the integrator's request for info and the overall system performance.
5. Capabilities using the Segment Manager's Dashboard Screens shall include:
    a. A dynamic "tile" based interface that allows easy viewing of each individual room's lighting and plug load power consumption, and lighting and plug load power density. Tiles will be automatically organized according to location so a single tile for the building summarizes all information for tiles beneath it on every floor, in every area, in every room. Tiles use three color coded energy target parameters, allowing an owner to quickly identify rooms that are not performing efficiently. Tiles for rooms with occupancy sensors shall include an icon to indicate whether that room is occupied. Tiles shall be clickable, and when clicked the underlying hierarchical level of tiles shall become visible. Tile interface shall be accessible via mouse, or touch screen devices. Tiles shall be created automatically by the segment manager, based on the

information found during the device discovery and/or information included in a file imported in from LMCS (such as tagged descriptions for each room) without any custom programming.

b. Ability to set up schedules for DLM local networks (rooms) and panels. Schedules shall be capable of controlling individual rooms with either on/off or normal hours/after hours set controlled zones or areas to either a normal hours or after hours mode of operation. Support for annual schedules, holiday schedules and unique date-bound schedules, as well as astro On or astro Off events with offsets. Schedules shall be viable graphically as time bars in a screen set up to automatically show scheduled events by day, week or month.

6. If shown on the Drawings, Segment Managers shall be integrated into a larger control network by the addition of a Network Supervisor package. The Supervisor is a server level computer running a version of the Segment Manager interface software with dedicated communication and networking capability, able to pull information automatically from each individual Segment Manager in the network. By using a Supervisor, information for individual Segment Managers can be accessed and stored on the Supervisor's hard drive, eliminating the risk of data being overwritten after a few days because of Segment Manager memory limits.
7. Segment Manager shall allow access and control of the overall system database via Native Niagara AX FOX connectivity. Systems that must utilize a Tridium Niagara controller in addition to the programming, scheduling and configuration server are not acceptable.

D. Segment Manager shall support multiple DLM rooms as follows:
1. Support up to 120 network bridges and 750 digital in-room devices (small networks).

2.9 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

B. Additional parameters exposed through this method include but are not limited to:
1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
5. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
6. Load control polarity reversal so that on events turn loads off and vice versa.

7. Per-load DR (demand response) shed level in units of percent.
8. Load output pulse mode in increments of 1second.
9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
1. Device list report: All devices in a project listed by type.
2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
5. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100 percent, 2 = all loads 75 percent, 3 = all loads 50 percent, 4 = all loads 25 percent, 5-16 = same as scene 1).
7. Occupancy sensor report: Basic settings including time delay and sensitivities for all occupancy sensors.

D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
1. Set, copy/paste an entire project site of sensor time delays.
2. Set, copy/paste an entire project site of sensor sensitivity settings.
3. Search based on room name and text labels.
4. Filter by product type to allow parameter set by product.
5. Filter by parameter value to search for product with specific configurations.

E. Network-wide firmware upgrading remotely via the BACnet/IP network.
1. Mass firmware update of entire rooms.
2. Mass firmware update of specifically selected rooms or areas.
3. Mass firmware upgrade of specific products

PART 3 EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

A. Install system in accordance with the approved system shop drawings and

manufacturer's instructions.

B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.
   1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested prior to proceeding with the Work.
   2. If fixtures have internal DLM Control Modules, ensure that they are also connected with Cat 5e cable.
   3. Install all room to room network devices using MSTP network wire.
   4. Low voltage wiring topology must comply with manufacturer's specifications.
   5. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.

D. Test all devices to ensure proper communication.

E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
   1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
   2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
   3. Load Parameters (e.g. blink warning, etc.)

G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.

H. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

I. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

J. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

K. Remote Access for Network Systems: If "REMOTE ACCESS AND ENHANCED WARRANTY FOR NETWORKED SYSTEMS" is specified in Part 1 of this specification, ensure Segment Manager enclosure is installed in a location with good to excellent cellular phone coverage based on building orientation and geographic location, and mount magnetic antenna for the modem. For cases where alternate mounting locations are not available and a stronger cellular signal is needed, the manufacturer shall offer additional antenna options to improve signal quality. Verify final mounting location with Engineer and Owner prior to proceeding with the Work.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
   1. Verify Class I and II wiring connections are terminated properly by validating system performance.
   2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
   3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
   4. Verify that the control of each space complies with the Sequence of Operation.
   5. Correct any system issues and retest.

C. Provide a report in table format with drawings or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
   1. Date of test or inspection.
   2. Loads per space, or Fixture Address identification.
   3. Quantity and Type of each device installed
   4. Reports providing each device's settings.

3.4 DEMONSTRATION AND TRAINING

A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:
   1. Confirmation of entire system operation and communication to each device.
   2. Confirmation of operation of individual relays, switches, and sensors.
   3. Confirmation of system Programming, photocell settings, override settings, etc.
   4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

3.5 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION 26 09 43

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush and/or Surface-mounted, as indicated on Drawings, dead-front cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   d. Wet or Damp Indoor Locations: NEMA 250, Type 4.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
2. Height: 84 inches (2.13 m) maximum.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

E. Phase, Neutral, and Ground Buses: Tin-plated aluminum.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Silver-plated hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

G. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices.

H. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2.

2.3 POWER PANELBOARDS

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

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

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

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 200 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:
        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Subfeed Circuit Breakers: Vertically mounted.
8. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NECA 407.

C. Mount panels at height above finished floor so that no operating handle of switch or circuit breaker in the on position is higher than 79 inches (2000 mm).

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.
1. Set field-adjustable, circuit-breaker trip ranges.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space if so constructed or space designated to be ceiling space in the future. Stub four 1-inch (27-EMT) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in "Identification for Electrical Systems."

E. Install warning signs complying with requirements in "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. USB receptacles.
4. SPD receptacles, 125 V, 20 A.
5. Twist-locking receptacles.
6. Toggle switches, 120/277 V, 20 A.
7. Wall plates.
8. Floor service fittings.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

E. RFI: Radio-frequency interference.

F. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
2. SPD Receptacles: One for every 10 of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Wiring Devices:

1. Bryant Electric, Inc., Hubbell Subsidiary.
2. Eagle Electric Manufacturing Co.
3. Hubbell Incorporated; Wiring Device-Kellems.
4. Leviton Mfg Company
5. Pass & Seymour/Legrand; Wiring Devices Div.

C. Floor Service Fittings:

1. FSR, Inc.
2. Wiremold/Legrand; Wiring Devices Div.
3. Hubbell Incorporated; Wiring Device-Kellems.
4. Leviton Mfg Company.

2.2 GENERAL WIRING DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

F. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

G. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.
3. SPD Devices: Blue.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.4 USB RECEPTACLES

A. USB Charging Receptacles:

1. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
2. USB Receptacles: Dual, USB Type A and Type-C, 5 V dc, and 2.4 A per receptacle (minimum).
3. Standards: Comply with UL 1310 and USB 3.0 devices.

2.5 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" article.

2.6 SPD RECEPTACLES, 125 V, 20 A

A. Duplex SPD Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. LED indicator light.
2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
4. Configuration: NEMA WD 6, Configuration 5-20R.
5. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.

2.7 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 250 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L6-20R.
2. Standards: Comply with UL 498.

2.8 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A.

1. Comply with UL 20 and FS W-S-896.

C. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:

1. Description: Illuminated when switch is “on”.
2. Standards: Comply with UL 20 and FS W-S-896.

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:

1. Description: For use with mechanically held lighting contactors.
2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.9 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Above-Floor Service Fittings:

1. Description: Type: Modular, above-floor, dual-service units suitable for wiring method used.
2. Service Plate: Rectangular satin finish.
3. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 26

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and SKM electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and SKM format electronic format.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.
2. Fuse Pullers: One for each size and type.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with NFPA 70.

2.2 MANUFACTURERS

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

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products

2.3 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

C. MCCBs shall be equipped with a device for locking in the isolated position.

D. Lugs shall be suitable for 194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.

E. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

G. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

H. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

I. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

J. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

K. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

L. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1), directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R) . The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. See SECTION 260500 “ELECTRICAL GENERAL REQUIREMENTS” for direction on scheduled interruptions.
2. Indicate method of providing temporary electric service.
3. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using the following method:

1) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION 26 28 16

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 26 32 13.13 - DIESEL EMERGENCY ENGINE GENERATORS

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 packaged diesel engine generators for emergency use with the following features:

1. Diesel engine.
2. Diesel fuel-oil system.
3. Horizontal, steel / concrete, fuel-oil ASTs.
4. Control and monitoring.
5. Generator overcurrent and fault protection.
6. Generator, exciter, and voltage regulator.
7. Outdoor engine generator enclosure.
8. Vibration isolation devices.
9. Finishes.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches, including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.3 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. Operational Bandwidth: The total variation, from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F (35, 27, 21, and 10 deg C). Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, Manufacturer, and testing agency.

B. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Report of sound generation.
4. Report of exhaust emissions showing compliance with applicable regulations.

C. Field quality-control reports.

D. Warranty: For special warranty.

E. This system shall be supplied by an original equipment manufacturer (OEM) who has been regularly engaged in the production of engine-alternator sets, automatic transfer switches, and associated controls for a minimum of 25 years, thereby identifying one source of supply and responsibility.

F. The manufacturer shall have printed literature and brochures describing the standard series specified, not a one-of-a-kind fabrication.

G. Manufacturer’s authorized service representative shall meet the following criteria:

1. Certified, factory trained, industrial generator technicians.
2. Service support 24/7.
3. Service location within 200 miles.
4. Response time of 4 hours.
5. Service & repair parts in-stock at performance level of 95%.
6. Offer optional remote monitoring and diagnostic capabilities.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Generac Power Systems

B. Caterpillar

C. Kohler Co.

D. Taylor Power Systems Inc.

E. AKSA Power Generation

F. Cummins, Inc.

G. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

H. Above ground Storage Tank (AST) to be provided by Convault or approved equal.

2.2 PERFORMANCE REQUIREMENTS

A. B11 Compliance: Comply with B11.19.

B. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 110 requirements for Level 2 EPSS.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C).
2. Altitude: Sea level to 1000 feet (300 m).

G. Unusual Service Conditions: Engine generator equipment and installation are required to operate under the following conditions:

1. High salt-dust content in the air due to sea-spray evaporation.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. EPSS Class: Engine generator shall be classified as a Class X (72hr) according to NFPA 110.

D. Service Load: 225 kVA.

E. Power Factor: 0.8, lagging.

F. Frequency: 60 Hz

G. Voltage: 208 V ac.

H. Phase: Three-phase, four-wire wye.

I. Induction Method: Turbocharged.

J. Governor: Adjustable isochronous, with speed sensing.

K. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

L. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

M. Engine Generator Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage, from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency, from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10 system requirements.

2.4 DIESEL ENGINE

A. Fuel: ASTM D975 diesel fuel oil, Grade 2-D S15.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant-system pressure for engine used. Equip with gage glass and petcock.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

E. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.

2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 80 dBA or less.

F. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

G. Starting System: 24 V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F (minus 40 to plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 30.

B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.

C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

D. Fuel Filtering: Remove water and contaminants larger than 1 micron.

E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

2.6 HORIZONTAL, STEEL / CONCRETE, FUEL-OIL AST

A. Manufacture fuel tank in accordance with UL 2085. Tank shall be capable of storing petroleum products with specific gravity up to 1.1 including fuel oils, specifically No. 2 diesel fuel at temperatures up to 150 degrees F.

B. Provide useable fuel tank volume of 133 percent. Allow 5 percent for sump volume and 5 percent for expansion. Size tank to store fuel supply for engine generator operating at full capacity for 72-hour minimum plus exercising the generator for 30 minutes monthly.

C. Provide fill cap with provisions to be locked closed. Provide required vents (emergency and vapor) with rainproof caps. Provide level controls and alarm to indicate fuel level. Provide rupture containment basin with 150% of tank capacity and fuel in basin alarm.

D. Provide stop cock and plug at tank drain. Provide isolation valve on tank discharge piping with provisions to be padlocked open.

E. Provide fuel distribution system in accordance with manufacturer's recommendations. Comply with recommended practices of NFPA.

F. The internal steel tank shall pass a 5 psig pressure test for a 24-hour period at the factory.

G. Tank(s) shall be tested in accordance with the Uniform Fire Code, Appendix llF, Proposed Test Requirements for Protected Tanks: Standard 79-7 (including impact and ballistic tests).

H. The internal tank shall have an emergency vent as required by the NFPA and Uniform Fire Code.

I. The secondary containment shall be pressure tested to 15ml, impervious to corrosion, including damage or failure due to microbial infestation. The secondary containment shall consist of a 30 Mil thick High-Density Polyethylene membrane enclosing the steel tank and insulation material.

J. The secondary containment shall have a ¼” annular space with the capability of physical monitoring. The tube for physical monitoring shall be at least ¾” internal diameter to accept leak detection cable. Access to the ¼” annular space shall be through a 1” female NPT opening.

K. The primary steel tank and the secondary containment shall be encased in six inches of monolithic reinforced concrete, with minimum design strength of 4,000 and 5,000 psi at 28 days depending on tank size. The concrete design shall include the following for long term durability:

a. Air Entrainment
b. Water reducing admixture
c. Steel reinforcement

L. The concrete shall be 6” of light-weight insulation concrete that is capable of preventing the internal tank temperature from rising more than 260 degrees F during a 2000 degrees F fire test for 2 hours.

M. The concrete shall not contain any aggregate/pea gravel.

N. The concrete shall be monolithic (seamless) and contain no cold joints, or heat transfer points between the internal and external tanks.

O. The steel tank openings shall be threaded except for the leak detector tubes.

P. Tanks and appurtenances shall have an exterior factory applied prime and finish coating of epoxy paint in accordance with Section 09 91 00 - Painting.

Q. Tanks shall have warning signs to indicate FLAMMABLE, NO SMOKING, a NFPA Placard H=0, F=2, R=0 and #2 diesel. Provide an identical NFPA placard on the entrance gate.

R. Lighting Protection:

a. Strike termination devices shall comply with Section 4.6 of NFPA 780.

b. Ground Rods shall be not less than 1/2" inch in diameter and 8ft long. Grounding rod materials specification and installation shall be in accordance with section 4.13.2 Ground Rods and 4.13.2.3 Ground Rod Depth of NFPA 780.

c. The ground rod termination down conductor shall be attached to the ground rod by bolting, brazing, welding or using high-compression connectors listed for the purpose. Clamps shall be suitable for direct soil burial. Lightning protection installation shall be in accordance with 4.13 of NFPA 780.

S. Capacities and Characteristics:

1. EPA Compliance: Comply with EPA and state and local authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks.
2. Capacity: 1300 gallons.
3. Fuel-Oil Grade Number: No.2 Diesel.
4. Warranty Period: 30 years from date of Substantial Completion.

2.7 CONTROL AND MONITORING

A. Automatic-Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of

engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum run time control set for 30 minutes, with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:

1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

    a. Engine lubricating-oil pressure gage.
    b. Engine-coolant temperature gage.
    c. DC voltmeter (alternator battery charging).
    d. Running-time meter.
    e. AC voltmeter, for each phase.
    f. AC ammeter, for each phase.
    g. AC frequency meter.
    h. Generator-voltage-adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 2 system, including the following:

    a. Cranking control equipment.
    b. Run-Off-Auto switch.
    c. Control switch not in automatic position alarm.
    d. Overcrank alarm.
    e. Overcrank shutdown device.
    f. Low water temperature alarm.
    g. High engine temperature pre-alarm.
    h. High engine temperature.
    i. High engine temperature shutdown device.
    j. Overspeed alarm.
    k. Overspeed shutdown device.
    l. Low-fuel main tank.
        1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for the duration required for the indicated EPSS class.
    m. Coolant low-level alarm.
    n. Coolant low-level shutdown device.

o. Coolant high-temperature prealarm.
p. Coolant high-temperature alarm.
q. Coolant low-temperature alarm.
r. Coolant high-temperature shutdown device.
s. Battery high-voltage alarm.
t. Low-cranking voltage alarm.
u. Battery-charger malfunction alarm.
v. Battery low-voltage alarm.
w. Lamp test.
x. Contacts for local and remote common alarm.
y. Low-starting air pressure alarm.
z. Low-starting hydraulic pressure alarm.
aa. Remote manual-stop shutdown device.
bb. Integral manual-stop NEMA 3R shutdown device installed adjacent to control panel door on exterior enclosure. Push button shall be protected from accidental operation.
cc. Hours of operation.
dd. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

F. Connection to Datalink:

1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
2. Provide connections for datalink transmission of indications to remote data terminals via ModBus.

G. Remote Alarm Annunciator: Comply with NFPA 99. An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Coolant low-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low-fuel main tank alarm.
8. Low coolant level alarm.
9. Low-cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Run-Off-Auto switch.
13. Control switch not in automatic position alarm.
14. Fuel tank derangement alarm.
15. Fuel tank high-level shutdown of fuel-supply alarm.
16. Lamp test.
17. Generator overcurrent protective device not closed.

H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.8 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.9 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

E. Enclosure: Aluminum Level 2 Acoustic Weatherproof Enclosure rated for 180mph wind speeds.

F. Instrument Transformers: Mounted within generator enclosure.

G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 30 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.

4. Maintain frequency within 15 percent and stabilize at rated frequency within five seconds.

H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

I. Subtransient Reactance: 12 percent, maximum.

2.10 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof aluminum housing, wind resistant up to 180 mph (290 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

1. Sound Attenuation Level:2.

B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads of up to 180 mph (290 km/h).

C. Hinged Doors: With padlocking provisions.

D. Space Heater: Thermostatically controlled and sized to prevent condensation.

E. Lighting: Provide weather-resistant LED lighting with 30-fc (330-lx) average maintained.

F. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

G. Muffler Location: Within enclosure.

H. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.

I. Interior Lights with Switch: Factory-wired, vapor-proof luminaires within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.

J. Convenience Outlets: Factory-wired GFCI. Arrange for external electrical connection.

2.11 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-

steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.12 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.13 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

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

3.2 PREPARATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect no fewer than (10) ten working days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's written permission.

3.3 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

E. Fuel Piping:

1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."
2. Copper and galvanized steel shall not be used in the fuel-oil piping system.

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.

C. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Additional requirements for diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.

F. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and in "Visual and Mechanical Inspection" and "Electrical and Mechanical Tests" subparagraphs below, as specified in the NETA ATS. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection:

        1) Compare equipment nameplate data with Drawings and the Specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that the unit is clean.

    b. Electrical and Mechanical Tests:

        1) Test protective relay devices.
        2) Verify phase rotation, phasing, and synchronized operation as required by the application.
        3) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        4) Conduct performance test according to NFPA 110.
        5) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component, indicating satisfactory completion of tests.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13

PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 26 36 00 - TRANSFER SWITCHES

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 automatic transfer switch rated 600 V and less, including the following:
   1. Remote annunciator system.
   2. Remote annunciator and control system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
   2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
   2. Include material lists for specified switch.
   3. Single-Line Diagram: Show connections between transfer switch, power source, and load.
   4. Riser Diagram: Show interconnection wiring between transfer switch, annunciator, and control panel.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    a. Features and operating sequence for automatic switch.
    b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 FIELD CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
    1. Notify Architect no fewer than 10 days in advance of proposed interruption of electrical service.
    2. Do not proceed with interruption of electrical service without Architect's written permission.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
    1. Warranty Period: 24 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
    1. Short-time withstand capability for 30 cycles.

F. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

G. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

H. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

I. Service-Rated Transfer Switch:

1. Comply with UL 869A and UL 489.
2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
3. In systems with a neutral, the bonding connection shall be on the neutral bus.
4. Provide removable link for temporary separation of the service and load grounded conductors.
5. Surge Protective Device: Service rated.
6. Service Disconnecting Means: Externally operated, manual mechanically actuated.

J. Neutral Terminal: Solid and fully rated unless otherwise indicated.

K. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

L. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable shrinkable sleeve markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

M. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Generac Power Systems

B. Caterpillar

C. Kohler Co.

D. Taylor Power Systems Inc.

E. AKSA Power Generation

F. Cummins, Inc.

G. Comply with Level 2 equipment according to NFPA 110.

H. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Switch Action: Double throw; mechanically held in both directions.
   2. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
   3. Conductor Connectors: Suitable for use with conductor material and sizes.
   4. Material: Tin-plated aluminum.
   5. Main and Neutral Lugs: Mechanical type.
   6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
   7. Connectors shall be marked for conductor size and type according to UL 1008.

I. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
   1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

J. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

K. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

L. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

M. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval shall be adjustable from 1 to 30 seconds.

N. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

O. Automatic Transfer-Switch Controller Features:
   1. Controller operates through a period of loss of control power.
   2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   5. Test Switch: Simulate normal-source failure.
   6. Switch-Position Pilot Lights: Indicate source to which load is connected.
   7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

2.3 TRANSFER SWITCH ACESSORIES

A. Remote Annunciator System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:
    a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
    b. Switch position.
    c. Switch in test mode.
    d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
    a. Indicating Lights: Grouped for each transfer switch monitored.
    b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
    c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
    d. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.4 SOURCE QUALITY CONTROL

A. Prepare test and inspection reports.
1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
    a. Overvoltage.

b. Undervoltage.
c. Loss of supply voltage.
d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.
f. Temperature rise.
g. Dielectric voltage-withstand; before and after short-circuit test.
h. Overload.
i. Contact opening.
j. Endurance.
k. Short circuit.
l. Short-time current capability.
m. Receptacle withstand capability.
n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.
1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
3. Provide workspace and clearances required by NFPA 70.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."

F. Route and brace conductors according to manufacturer's written instructions and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.

G. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches (457 mm) in length.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. After installing equipment, test for compliance with requirements according to NETA ATS.
   2. Visual and Mechanical Inspection:
      a. Compare equipment nameplate data with Drawings and Specifications.
      b. Inspect physical and mechanical condition.
      c. Inspect anchorage, alignment, grounding, and required clearances.
      d. Verify that the unit is clean.
      e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
      f. Verify that manual transfer warnings are attached and visible.
      g. Verify tightness of all control connections.
      h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
         1) Use of low-resistance ohmmeter.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
      i. Perform manual transfer operation.
      j. Verify positive mechanical interlocking between normal and alternate sources.
      k. Perform visual and mechanical inspection of surge arresters.
      l. Inspect control power transformers.
         1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
         2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
         3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
   3. Electrical Tests:
      a. Perform insulation-resistance tests on all control wiring with respect to ground.
      b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
      c. Verify settings and operation of control devices.

d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:
1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
a. Check for electrical continuity of circuits and for short circuits.
b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Transfer switches will be considered defective if they do not pass tests and inspections.

F. Remove and replace malfunctioning units and retest as specified above.

G. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Type 1 surge protective devices.
2. Type 2 surge protective devices.
3. Enclosures.
4. Conductors and cables.

B. Related Requirements:

1. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
2. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.2 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: air of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. NRTL: Nationally recognized testing laboratory.

F. OCPD: Overcurrent protective device.

G. SCCR: Short-circuit current rating.

H. SPD: Surge protective device.

I. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

J. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

K. Type 3 SPDs: Point of utilization SPDs.

L. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include electrical characteristics, specialties, and accessories for SPDs.
2. NRTL certification of compliance with UL 1449.

a. Tested values for VPRs.
b. Inominal ratings.
c. MCOV, type designations.
d. OCPD requirements.
e. Manufacturer's model number.
f. System voltage.
g. Modes of protection.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

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

1. APT, a division of Schneider Electric
2. SSI, an ILSCO Company
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products
5. G.E., a division of ABB

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. Standards:

1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.

D. Product Options:

1. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
2. Include indicator light display for protection status.
3. Include audible alarm.
4. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V ac for remote monitoring of protection status.
5. Include surge counter.

E. Performance Criteria:

1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems.
2. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 240 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
3. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits must not exceed the following:

    a. Line to Neutral: 700 V for 208Y/120 V.
    b. Line to Line: 1200 V for 208Y/120 V.

4. SCCR: Not less than 200 kA.
5. Inominal Rating: 20 kA.

2.2 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

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

1. APT, a division of Schneider Electric
2. SSI, an ILSCO Company
3. Siemens Energy & Automation, Inc.
4. Eaton Corporation, Cutler-Hammer Products
5. G.E., a division of ABB

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. Standards:

1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
2. Comply with UL 1283.

D. Product Options:

1. Include LED indicator lights for power and protection status.

2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V ac for remote monitoring of protection status.
4. Include surge counter.

E. Performance Criteria:

1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V power systems.
2. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
3. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits must not exceed the following:

    a. Line to Neutral: 700 V for 208Y/120 V.
    b. Line to Ground: 700 V for 208Y/120 V.
    c. Neutral to Ground: 700 V for 208Y/120 V.
    d. Line to Line: 1200 V for 208Y/120 V.

4. SCCR: Equal or exceed 100 kA.
5. Inominal Rating: 10 kA.

2.3 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

2.4 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's written instructions.

C. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's written instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
2. Do not exceed manufacturer's recommended lead length.
3. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. SPDs that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 26 43 13

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Downlight.
2. Highbay, linear.
3. Linear industrial.
4. Recessed, linear.
5. Surface mount, linear.
6. Suspended, linear.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

B. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C).

B. Altitude: Sea level to 1000 feet (300 m).

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp module characteristics:

a. Manufacturer

b. Model number

c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. Luminaire CRI requirements: Greater than 80 CRI unless noted otherwise on Drawings.

G. Luminaire CCT requirements: 4000K unless noted otherwise on Drawings.

H. Luminaire Lumen outputs: As indicated on Drawings or comparable with luminaire model specified on Drawings.

I. Luminaire Rated Lamp Life: As comparable with luminaire model specified on Drawings.

2.3 DOWNLIGHT

A. Nominal Operating Voltage: 120 V ac or 277 V ac, or as indicated on Drawings.

1. Dimmable from 100 percent to 10 percent of maximum light output.
2. Internal driver.

B. Housings:

1. Forged-aluminum housing and heat sink.
2. Clear anodized finish.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. Recessed luminaires shall comply with NEMA LE 4.

2.4 HIGHBAY, LINEAR

A. Nominal Operating Voltage: 120 V ac or 277 V ac, or as indicated on Drawings.

1. Dimmable from 100 percent to 10 percent of maximum light output.
2. Internal driver.

B. Housings:

1. Aluminum and Steel housing and heat sink.
2. Powder-coat finish.
3. With integral mounting provisions.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Standards:

1. ENERGY STAR certified.

2. RoHS compliant.
3. UL Listing: Listed for damp location.

2.5 LINEAR INDUSTRIAL

A. Nominal Operating Voltage: 120 V ac or 277 V ac, or as indicated on Drawings.

1. Dimmable from 100 percent to 10 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

B. Housings:

1. Polycarbonate housing and heat sink.
2. Painted finish.
3. With integral mounting provisions.
4. IP 66.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.

2.6 RECESSED, LINEAR

A. Nominal Operating Voltage: 120 V ac or 277 V ac, or as indicated on Drawings.

1. Dimmable from 100 percent to 10 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

B. Housings:

1. Polycarbonate housing and heat sink.
2. With integral mounting provisions.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.
4. NEMA LE 4.

2.7 SURFACE MOUNT, LINEAR

A. Nominal Operating Voltage: 120 V ac or 277 V ac, or as indicated on Drawings.

1. Dimmable from 100 percent to 10 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

B. Housings:

1. Polycarbonate housing and heat sink.
2. With integral mounting provisions.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.

2.8 SUSPENDED, LINEAR

A. Nominal Operating Voltage: 120 V ac or 277 V ac, or as indicated on Drawings.

1. Dimmable from 100 percent to 10 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

B. Housings:

1. Extruded-aluminum housing and heat sink.
2. Powder-coat paint finish.
3. With integral mounting provisions.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.

E. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.

2.9 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.10 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.11 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: Minimum 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaires:

1. Pendants, Aircraft Cable and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

3.5 ADJUSTING

A. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION 26 51 19

THIS PAGE INTENTIONALLY LEFT BLANK

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 26 52 13 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exit signs.
2. Luminaire supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire" Paragraph.

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:

1. For emergency lighting units.
2. For exit signs.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Luminaire-mounted, emergency battery pack: One for every 50 emergency lighting units. Furnish at least one of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.
2. Warranty Period for Self-Powered Exit Sign Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.

1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
2. Battery: Sealed, maintenance-free, nickel-cadmium type.
3. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
4. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

F. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
2. Battery: Sealed, maintenance-free, nickel-cadmium type.
3. Charger: Fully automatic, solid-state, constant-current type.
4. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the driver or emergency power unit manufacturer, whichever is less.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EMERGENCY LIGHTING

A. Emergency Luminaires:

1. Emergency Luminaires: Interior Luminaire Schedule and Drawings.

a. Operating at nominal voltage of 120 V ac or 277 V ac
b. Internal or External emergency power unit per specified fixture type.
c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
d. UL 94 flame rating.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Operating at nominal voltage of 120 V ac or 277 V ac
2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Housings:

1. Cast Aluminum housing.
2. Satin Brushed finish.

D. Conduit: Electrical metallic tubing, minimum 3/4 inch (21 mm) in diameter.

2.5 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

3.5 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.

    a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 26 52 13

SECTION 26 56 13 - LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.

1.3 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete luminaire.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting device, arranged as indicated.

1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
2. Include finishes for lighting poles and luminaire-supporting devices.
3. Anchor bolts.
4. Manufactured pole foundations.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

1.5 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Material Test Reports:

1. For each foundation component, by a qualified testing agency.
2. For each pole, by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranty: Manufacturer's standard warranty.

E. Soil test reports

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include pole inspection and repair procedures.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B660.

B. Store poles on decay-resistant skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on poles until right before pole installation. Handle poles with web fabric straps.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of poles that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Structural Characteristics: Comply with AASHTO LTS-6-M.

C. Dead Load: Weight of luminaire and its horizontal and vertical supports, and supporting structure, applied according to AASHTO LTS-6-M.

D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 180 mph (81 m/s).

    a. Risk Category: As determined by FBC Table 1604.5
    b. Minimum Design Life:25 years
    c. Wind Load: Ultimate Design Wind Speed as calculated using FBC Section 1609.

E. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.3 to obtain the EPA to be used in pole selection strength analysis.

F. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 ALUMINUM POLES

A. Poles: extruded structural tube complying with ASTM B221, with access handhole in pole wall.

1. Shape: Round, tapered.

2. Mounting Provisions: Butt flange for bolted mounting on foundation.

B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

C. Grounding and Bonding Lugs: Bolted 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Fasteners: Stainless steel size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

E. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

G. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.

a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils (64- to 89-um) dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
b. Color: As selected by Architect from manufacturer's full range.

2.3 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.4 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F1554, Grade 55, with a minimum yield strength of 55,000 psi (380 000 kPa).

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
2. Headed rods 7/8”inches (22mm) in diameter by 18 inches (457mm) in length.
3. Threading: Uniform National Coarse Class 2A.

B. Nuts: ASTM A563, Grade A, Heavy-Hex.

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
2. Two nuts provided per anchor bolt.

C. Washers: ASTM F436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
2. Two washer(s) provided per anchor bolt.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.

1. Fire Hydrants and Water Piping: 60 inches (1520 mm).
2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet (3 m).
3. Trees: 15 feet (5 m) from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.

D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
2. Install base covers unless otherwise indicated.
3. Use a short piece of 1/2 -inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 26 56 13

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 56 19 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting.
2. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.

    a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

5. Wiring diagrams for power, control, and signal wiring.
6. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

1.5 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One for every 50 of each type and rating installed.
2. Globes and Guards: One for every 50 of each type and rating installed.

1.8 QUALITY ASSURANCE

A. Provide luminaires from a single manufacturer for each luminaire type.

B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

C. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

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

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: (1) One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598 and U.L. Listed for wet location if indicated.

D. CRI: Minimum of 70 CRI

E. CCT: 3000 K unless noted otherwise or is specific to wildlife lighting requirements.

F. L70 lamp life of 50,000 hours.

G. Internal driver.

H. Nominal Operating Voltage: 120 V ac or 208 V ac.

I. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE TYPES

A. Area and Site:

1. Mounting: Pole or Building mounting as indicated.
2. Distribution: Type II, Type III, Type IV, or Type V as indicated.
3. Housings:

a. Cast-aluminum housing and heat sink.
b. Powder-coat painted finish.

B. Canopy:

1. Housings:

a. Extruded-aluminum housing and heat sink.
b. Powder-coat painted finish.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum or Stainless steel. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

F. Factory-Applied Labels: Comply with UL 1598. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles where located in place.

1. Label shall include the following characteristics:

a. CCT and CRI for all luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

    a. Color: As selected from manufacturer's standard catalog of colors.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Fasten luminaire to structural support.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

E. Wiring Method: Install cables in raceways. Conceal raceways and cables.

F. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at heights as indicated on Drawings.

G. Coordinate layout and installation of luminaires with other construction.

H. Adjust luminaires that require field adjustment or aiming.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Install on concrete base with top 6 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

B. Luminaire will be considered defective if it does not pass tests and inspections.

3.7 ADJUSTING

A. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions.

Make up to two visits to project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 26 56 19

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding rods.
5. Grounding labeling.

1.2 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. EMT: Electrical metallic tubing.

C. TGB: Telecommunications grounding busbar.

D. TMGB: Telecommunications main grounding busbar.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground rods.
2. Ground and roof rings.
3. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For **Installer,** installation supervisor, and field inspector.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installation Supervision: Installation shall be under the direct supervision of ITS **Technician** who shall be present at all times when Work of this Section is performed at Project site.
2. Field Inspector: Currently registered by BICSI as an **RCDD** to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

A. Comply with J-STD-607-A.

2.2 CONDUCTORS

A. Comply with UL 486A-486B.

B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: **No. 6** AWG.

C. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

C. Busbar Connectors: Cast silicon bronze, solderless **compression**-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, **1/4 by 4 inches** in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a **4-inch** clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

B. TGB: Predrilled rectangular bars of hard-drawn solid copper, **1/4 by 2 inches** in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch ((50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.)
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches ((1827 or 914 mm) long, with) stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

A. Ground Rods: **Copper-clad**; **3/4 inch by 10 feet** in diameter.

2.6 LABELING

A. Comply with TIA 606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with J-STD-607-A.

3.3 APPLICATION

A. Conductors: Install solid conductor for **No. 8** AWG and smaller and stranded conductors for **No. 6** AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than **No. 6** AWG.

2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than **No. 6** AWG.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

C. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches ((900 mm).)

D. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.
4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

    a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than **No. 3/0** AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than **No. 6** AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG **168 kcmils (85 sq. mm)** unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install **top-mounted** rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA 568 when grounding screened, balanced, twisted-pair cables.

J. Rack and Cabinet Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

    a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

    a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB. Maximum acceptable ac current level is 1 A.

C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds **5** ohms, notify Architect promptly and include recommendations to reduce ground resistance.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 270526

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Surface pathways.
5. Boxes, enclosures, and cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: **Steel**.
b. Type: **Setscrew or compression**.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

F. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Continuous HDPE: Comply with UL 651B.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway, approved for **plenum, riser or general-use** installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569.

2.4 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569.

B. Surface Nonmetallic Pathways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL-94 V-0 requirements for self-extinguishing characteristics.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, **aluminum**, Type FD, with gasketed cover.

D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

E. Metal Floor Boxes:

1. Material: **Cast metal or sheet metal**.
2. Type: **Fully adjustable**.
3. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, **cast aluminum** with gasketed cover.

H. Device Box Dimensions: **4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)**.

I. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, **Type 1** OR **Type 3R** with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, **Type 1** or **Type 3R** galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: **GRC**.
2. Concealed Conduit, Aboveground: **GRC**, **EMT**, **RNC, Type EPC-40-PVC**.
3. Boxes and Enclosures, Aboveground: NEMA 250, **Type 3R**.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: **EMT**.
2. Exposed, Not Subject to Severe Physical Damage: **EMT**
3. Exposed and Subject to Severe Physical Damage: GRC.
4. Concealed in Ceilings and Interior Walls and Partitions: **EMT**
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: **Plenum-type, optical-fiber-cable pathway**, **Plenum-type, communications-cable pathway, or EMT.**
7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: **EMT**.
8. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 **stainless steel** in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use **setscrew or compression**, **steel** or **cast-metal** fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F (49 deg C)**.

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Arrange stub-ups so curved portions of bends are not visible above finished slab.

D. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

E. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

F. Stub-ups to Above Recessed Ceilings:

1. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

G. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

H. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

I. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

K. Spare Pathways: Install pull wires in empty pathways. Cap underground pathways designated as spare above grade alongside pathways in use.

L. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.

M. Pathways for Optical-Fiber and Communications Cable: Install pathways as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements.

N. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound.

O. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

4. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
5. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
6. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

P. Mount boxes at heights indicated on Drawings in accordance with ADA requirements. Install boxes with height measured to **center** of box unless otherwise indicated.

Q. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

END OF SECTION 270528

SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ladder cable trays.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of cable tray.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles on individual cable tray types for specific values for uniform load distribution, concentrated load, and load and safety factor parameters.

2.2 LADDER CABLE TRAYS

A. Description:

1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
2. Rung Spacing: **12 inches (300 mm)** o.c.
3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
5. No portion of the rungs shall protrude below the bottom plane of side rails.
6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
7. Minimum Usable Load Depth: **3 inches**

8. Straight Section Lengths: **10 feet (3 m)** where shorter lengths are required to facilitate tray assembly.
9. Width: **12 inches (300 mm)**, **18 inches (450 mm),** or **24 inches (600 mm)** unless otherwise indicated on Drawings.
10. Fitting Minimum Radius: **12 inches (300 mm)**, **24 inches (600 mm) or as required**.
11. Class Designation: Comply with NEMA VE 1, **Class 12B**
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Hardware and Fasteners: **ASTM F 593 and ASTM F 594 stainless steel, Type 316**.
14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.3 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of **ASTM A 1011/A 1011M, SS, Grade 33**.
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.

    a. Hardware: **Galvanized, ASTM B 633**.

5. Finish: Electrogalvanized before fabrication.
6. Finish: Hot-dip galvanized after fabrication.

    a. Hardware: **Chromium-zinc plated, ASTM F 1136**.

7. Finish: **Epoxy-resin** paint.

    a. Hardware: **Chromium-zinc plated, ASTM F 1136**

8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.

B. Aluminum:

1. Materials: Alloy 6063-T6 according to ANSI H35.1/H 35.1M for extruded components, and **Alloy 5052-H32** according to ANSI H35.1/H 35.1M for fabricated parts.
2. Hardware: **Chromium-zinc-plated steel, ASTM F 1136**.
3. Hardware for Aluminum Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.4 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

A. Lettering: **1-1/2-inch- (40-mm-)** high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Electrical Specifications.

2.6 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to **NEMA VE 1**.

PART 3 - EXECUTION

3.1 CABLE TRAY INSTALLATION

A. Install cable trays according to **NEMA VE 2**.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Fasten cable tray supports to building structure.

D. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 200 lb (90 kg). Comply with requirements in Electrical Specifications.

E. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

F. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

G. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in **NEMA VE 2**. Space connectors and set gaps according to applicable standard.

H. Seal penetrations through fire and smoke barriers.

I. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

J. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

K. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

L. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.2 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

D. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.3 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

E. Tie MI cables down every 36 inches (900 mm) where required to provide a 2-hour fire rating and every 72 inches (1800 mm) elsewhere.

F. In existing construction, remove inactive or dead cables from cable trays.

3.4 CONNECTIONS

A. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
8. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect installed cable trays and cables.

END OF SECTION 270536

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Grounding.

B. Related Requirements:
1. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of a Commercial Installer.
2. Installation Supervision: Installation shall be under the direct supervision of a BICSI Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.
4. Contractor shall be certified under Belden's 25-year certification.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.2 EQUIPMENT FRAMES

A. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

B. Floor-Mounted Racks: Modular-type, steel or aluminum construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug.
2. Baked-polyester powder coat finish.

C. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.3 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.

3. Six, 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. Close-coupled, direct plug-in line cord.
9. Rocker-type on-off switch, illuminated when in on position.
10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Refer to drawings for bus bar requirements.

C. Comply with J-STD-607-A.

2.5 LABELING

A. Comply with TIA 606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.4 FIRESTOPPING

A. Comply with TIA-569, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA 606. Comply with requirements in Division 26.

B. Comply with requirements in Division 09 for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA 606 for Class 2 level of administration.

D. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cable.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Cabling identification products.

B. Related Sections:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA 568, when tested according to test procedures of this standard.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.

3. Wiring diagrams to show typical wiring schematics including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Layout Responsibility: Preparation of Shop Drawings by approved by a BICSI certified RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of **a BICSI Level 2 Installer**, who shall be present at all times when Work of this Section is performed at Project site.
3. Contractor shall be certified under Belden's 25-year certification. Must contractor must be certified at least 6 months prior to bid.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: **25** or less.
2. Smoke-Developed Index: **50** or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Telecommunications Pathways and Spaces: Comply with TIA 569.

E. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.
4. Refer to 270536 for cable/ladder tray requirements.

B. Conduit and Boxes: Comply with requirements in Electrical Specifications.

2.2 BACKBOARDS

A. Backboards: Plywood, **fire-retardant treated,** 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.3 UTP CABLE

A. Description: 250-ohm, 4-pair UTP, formed into 12 cable groups covered with a **gray** thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA 568 for performance specifications.
3. Comply with TIA 568, **Category 6A**.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG**; or MPP, CMP, MPR, CMR, MP, or MPG**.
b. Communications, Plenum Rated: Type CMP **or MPP**, complying with NFPA 262.
c. Communications, Riser Rated: Type CMR**; or MPP, CMP, or MPR**, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. General Requirements for Cable Connecting Hardware: Comply with TIA 568, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

B. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair **conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria**.

C. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

D. Patch Cords: Factory-made, 4-pair cables in lengths as required by IT personnel; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.5 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA 606 and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA 568.

C. Factory test UTP cables according to TIA 568.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Electrical Specifications.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA 569.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA 569 for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Electrical Specifications for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits **3 inches (76 mm)** above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA 568.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA 568.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than **60 inches (1524 mm)** apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA 569 recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

A. Comply with TIA 569, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect

grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA 606. Comply with requirements for identification specified in Electrical Specifications.

1. Administration Class: **1**.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA 606 for Class 2 level of administration.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, **backbone pathways and cables,** terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting

hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA 568.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA 568. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION 271300

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Cable connecting hardware, patch panels, and cross-connects.
3. Telecommunications outlet/connectors.
4. Cabling system identification products.

B. Related Requirements:

1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
2. Wiring diagrams to show typical wiring schematics, including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

3. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Layout Responsibility: Preparation of Shop Drawings by BICSI certified RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of **a BICSI Level 2 Installer**, who shall be present at all times when Work of this Section is performed at Project site.
3. Contractor shall be certified under Belden's 25-year certification.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA 568 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA 568 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: **25** or less.
2. Smoke-Developed Index: **50** or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

A. Backboards: Plywood, **fire-retardant treated,** 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.4 UTP CABLE

A. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA 568 for performance specifications.
3. Comply with TIA 568 **Category 6A**.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, General Purpose: Type CM or CMG.
    b. Communications, Plenum Rated: Type CMP complying with NFPA 262.
    c. Communications, Riser Rated: Type CMR, complying with UL 1666.

2.5 UTP CABLE HARDWARE

A. General Requirements for Cable Connecting Hardware: Comply with TIA 568, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

B. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: **One** for each four-pair **conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria**.

C. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

D. Patch Cords: Factory-made, four-pair cables in lengths as required by IT personnel; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6A performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA 568.

B. Workstation Outlets: **Two**-port-connector assemblies mounted in **multigang** faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Electrical Specifications.
2. Metal Faceplate: **Stainless steel** complying with requirements in Electrical Specifications.
3. For use with snap-in jacks accommodating any combination of UTP work area cords.

    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

4. Legend: Factory labeled by silk-screening or engraving **for** s**tainless steel faceplates**.
5. Legend: Machine printed, in the field, using adhesive-tape label.
6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.7 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA 606 and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Electrical Specifications.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA 568.

C. Factory test UTP cables according to TIA 568.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters **and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used**. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements in Section 270528 "Pathways for Communications Systems."
3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA 568.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA 568.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than **60 inches (1524 mm)** apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA 569 for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with TIA 569, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA 606. Comply with requirements for identification specified in Electrical Specifications.

1. Administration Class: **1**.
2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 09 for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA 606 for **Class 2** level of administration.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, **backbone pathways and cables,** terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA 606. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA 568.
2. Visually confirm **Category 6A,** marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA 568. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

    a. Test for each outlet and MUTOA. Perform the following tests according to TIA 568:

        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

    a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
    b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. **Train** Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

SECTION 27 51 16 - PUBLIC ADDRESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preamplifiers.
2. Power amplifiers.
3. Microphones.
4. Equipment cabinet.
5. Telephone paging adapters.
6. Tone generator.
7. Loudspeakers.
8. Noise-operated gain controllers.
9. Microphone and headphone outlets.
10. Conductors and cables.
11. Pathways.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Power, signal, and control wiring.

C. Delegated-Design Submittal: For supports and seismic restraints for control consoles, equipment cabinets and racks, and components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of supports and seismic restraints for control consoles, equipment cabinets and racks, and components.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain public address system from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

2.2 FUNCTIONAL DESCRIPTION OF SYSTEM

A. System Functions:

1. Selectively connect any zone to any available signal channel.
2. Selectively control sound from microphone outlets and other inputs.
3. "All-call" feature shall connect the all-call sound signal simultaneously to all zones regardless of zone or channel switch settings.
4. Telephone paging adapter shall allow paging by dialing an extension from any local telephone instrument and speaking into the telephone.
5. Produce a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.
6. Reproduce high-quality sound that is free of noise and distortion at all loudspeakers at all times during equipment operation including standby mode with inputs off; output free of nonuniform coverage of amplified sound.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports and seismic restraints for control consoles, equipment cabinets and racks, and components, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.4 SYSTEM DESCRIPTION

A. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

C. Equipment Mounting: Where rack, cabinet, or console mounting is indicated, equipment shall be designed to mount in a 19-inch (483-mm) housing complying with EIA/ECA-310-E.

D. Weather-Resistant Equipment: Listed and labeled by a qualified testing agency for duty outdoors or in damp locations.

2.5 PREAMPLIFIERS

A. Preamplifier: Separately mounted.

B. Preamplifier: Integral to power amplifier.

C. Output Power: Plus 4 dB above 1 mW at matched power-amplifier load.

D. Total Harmonic Distortion: Less than 1 percent.

E. Frequency Response: Within plus or minus 2 dB from 20 to 20,000 Hz.

F. Input Jacks: Minimum of three. One matched for low-impedance microphone; one USB port; and the other matchable to DVD or CD player, or radio tuner signals without external adapters.

G. Minimum Noise Level: Minus 55 dB below rated output.

H. Controls: On-off, input levels, and master gain.

2.6 POWER AMPLIFIERS

A. Mounting: Rack.

B. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus a 10 percent allowance for future stations.

C. Total Harmonic Distortion: Less than 3 percent at rated power output from 50 to 12,000 Hz.

D. Minimum Signal-to-Noise Ratio: 80 dB, at rated output.

E. Frequency Response: Within plus or minus 3 dB from 20 to 12,000 Hz.

F. Output Regulation: Less than 2 dB from full to no load.

G. Controls: On-off, input levels, and low-cut filter.

H. Input Sensitivity: Matched to preamplifier and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphone or handset transmitter.

2.7 MICROPHONES

A. Paging Microphone:

1. Type: Dynamic, with cardioid polar characteristic.

2. Impedance: 500 ohms.
3. Frequency Response: Uniform, 50 to 15,000 Hz.
4. Sensitivity: Minus 70 dB.
5. Output Level: Minus 58 dB, minimum.
6. Cable: Braided shield cable with Neutrik XLR connectors. Coordinate impedance with microphone impedance.
7. Mounting: Desk stand with integral-locking, press-to-talk switch.

2.8 CONTROL CONSOLE

A. Cabinet: Modular, desktop, complying with EIA/ECA-310-E.

B. Housing: Steel, 0.0478 inch (1.2 mm) minimum, with removable front and rear panels. Side panels are removable for interconnecting side-by-side mounting.

C. Panel for Equipment and Controls: Rack mounted.

D. Controls:

1. Switching devices to select signal sources for distribution channels.
2. Program selector switch to select source for each program channel.
3. Switching devices to select zones for paging.
4. All-call selector switch.

E. Indicators: A visual annunciation for each distribution channel to indicate source being used.

F. Self-Contained Power and Control Unit: A single assembly of basic control, electronics, and power supply necessary to accomplish specified functions.

G. Spare Positions: 20 percent spare zone control and annunciation positions on console.

H. Microphone jack.

2.9 LOUDSPEAKERS

A. Cone-Type Loudspeakers:

1. Minimum Axial Sensitivity: 91 dB at 1 m, with 1-W input.
2. Frequency Response: Within plus or minus 3 dB from 50 to 15,000 Hz.
3. Size: 6 inches (150 mm) with 1-inch (25-mm) voice coil and minimum 5-oz. (140-g) ceramic magnet.
4. Rated Output Level: 8 W.
5. Minimum Dispersion Angle: 100 degrees.
6. Matching Transformer: Full-power rated with four taps. Maximum insertion loss of 0.5 dB.
7. Surface-Mounted Units: Ceiling, wall, or pendant mounted, as indicated, in steel back boxes, acoustically dampened. Front face of at least 0.0478-inch (1.2-mm) steel and whole assembly rust proofed and shop primed for field painting.
8. Flush-Ceiling-Mounted Units: In steel back boxes, acoustically dampened. Metal ceiling grille with white baked enamel.

B. Horn-Type Loudspeakers:

1. Type: Single-horn units, double-reentrant design, with minimum full-range power rating of 15 W.
2. Matching Transformer: Full-power rated with four standard taps. Maximum insertion loss of 0.5 dB.
3. Frequency Response: Within plus or minus 3 dB from 250 to 12,000 Hz.
4. Dispersion Angle: 130 by 110 degrees.
5. Mounting: Integral bracket.
6. Units in Damp, Wet, or Outdoor Locations: Listed and labeled for environment in which they are located.
7. Units in Hazardous (Classified) Locations: Listed and labeled for environment in which they are located. Provide any accessories required to maintain listing.

2.10 OUTLETS

A. Microphone Outlet: Three-pole, polarized, locking-type, microphone receptacles in single-gang boxes. Equip wall outlets with brushed stainless-steel device plates. Equip floor outlets with gray tapered rubber or plastic cable nozzles and fixed outlet covers.

2.11 CONDUCTORS AND CABLES

A. Jacketed, twisted pair and twisted multipair, untinned solid copper.

1. Insulation for Wire in Conduit: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.
2. Microphone Cables: Neoprene jacketed, not less than 2/64 inch (0.8 mm) thick, over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
3. Plenum Cable: Listed and labeled for plenum installation.

2.12 PATHWAYS

A. Conduit and Boxes: Comply with Section 270528 "Pathways for Communications Systems."

1. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in pathways except within consoles, cabinets, desks, and counters. Conceal pathway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for pathways and boxes specified in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Comply with requirements in Section 270528 "Pathways for Communications Systems." for installation of conduits and wireways.

B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Cable Installation Requirements:

1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceiling by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run together with network cabling or through structural members or be in contact with pipes, ducts, or other potentially damaging items.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate pathways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and

adjacent parallel power and telephone wiring. Separate other communication equipment conductors as recommended by equipment manufacturer.

3.4 INSTALLATION

A. Coordinate layout and installation of system components 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.

B. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

C. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

D. Equipment Cabinets and Racks:

1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.
3. Blank Panels: Cover empty space in equipment racks so entire front of rack is occupied by panels.

E. Wall-Mounted Outlets: Flush mounted.

F. Floor-Mounted Outlets: Conceal in floor and install cable nozzles through outlet covers. Secure outlet covers in place. Trim with carpet in carpeted areas.

G. Conductor Sizing: Unless otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 18 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

H. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

I. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.

J. Connect wiring according to Section 271500 "Communications Horizontal Cabling".

3.5 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Section 270526 "Grounding and Bonding for Communications Systems."

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Schedule tests with at least seven days' advance notice of test performance.
2. After installing public address system and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: Perform tests that include originating program and page messages at microphone outlets, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and that system is free of noise and distortion.
4. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each zone. For spaces with seated audiences, maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.
5. Power Output Test: Measure electrical power output of each power amplifier at normal gain settings of 50, 1000, and 12,000 Hz. Maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

C. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

D. Public address system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

1. Include a record of final speaker-line matching transformer-tap settings and signal ground-resistance measurement certified by Installer.

3.7 ADJUSTING

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

END OF SECTION 275116

SECTION 28 46 21.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Digital alarm communicator transmitter.

B. Related Requirements:

1. Section "Control Voltage Electric Power Cables" for cables and conductors for fire-alarm systems.

1.2 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.
13. Include alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.4 QUALITY ASSURANCE

A. Each and all items of the fire alarm system shall be listed as a product of a single fire alarm manufacturer under the appropriate category by Underwriters' Laboratories, Inc. (UL), and shall bear the "UL" label. All control equipment shall be listed under UL Category UOJZ as a single control unit. Partial listing will not be acceptable.

B. All control equipment shall have transient protection devices to comply with UL 864 requirements.

C. Manufacturer's Qualifications: All fire alarm equipment shall be the product of one manufacturer. System appliances and devices not manufactured by the control panel manufacturer shall be products regularly distributed by the control panel manufacturer and cross-listed by Underwriter's Laboratories for compatibility with the system control panel.

D. Installer's Qualifications: The installation and testing of all components of the system shall be performed by a Contractor holding a current certification issued by the State of Florida

Department of Professional Regulation. The Contractor shall be certified as either an Alarm System Contractor – Type 1 or an Unlimited Electrical Contractor.

E. The fire alarm Contractor shall be an experienced firm regularly engaged in the layout and installation of automatic fire alarm systems. The Contractor shall have successfully completed the installation, testing, and warranty of systems of the scope of the largest system on this project at least three years prior to bid, and have regularly engaged in the business of fire alarm systems contracting continuously since.

F. The fire alarm Contractor shall have been certified by the State of Florida Department of Professional Regulation to install fire alarm systems, have been NICET Level III certified, and certified by one of the above listed approved equipment manufacturer to perform installation, testing, adjustment, maintenance, and repair on the approved manufacturer's equipment prior to the date of bid. The proposed fire alarm Contractor shall commence no work on the project until he furnishes evidence, satisfactory to the aforementioned certifications and receives notice to proceed with the installation from the Architect.

G. Firms shall have been factory authorized service organization and stock spare parts.

H. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.5 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.6 WARRANTY AND MAINTENANCE:

A. The Contractor shall supply a 3-year warranty from date of commissioning for all Control System and Field Devices and appliances. The Contractor shall warrant the installed fire alarm system to be free from defects of material and installation for a period of 3 years from acceptance by the Architect. Any deficiencies shall be immediately corrected at no additional cost to the Owner. The Contractor shall maintain a service organization with adequate spare parts stock within 150 miles of the installation. Any defects that render the system inoperative shall be repaired within 24 hours of the Owner notifying the Contractor. Other defects shall be repaired within 48 hours of the Owner notifying the Contractor.

B. The Factory Trained and Authorized Contractor who Designed and Installed this system shall provide a separate maintenance contract for a period of 3 Years from the date of system warranty expiration. As part of the systems maintenance, the installing Contractor will provide printed out reports which detail the sensitivity of each smoke detector installed in the system, and the date of the report.

C. The Fire Alarm System supplied shall include a store of spare system sub-assemblies and field devices for use as emergency service stock. As a minimum, the spares stock shall include 2% of each different type of field connected device.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. The Fire Alarm System supplied under this specification shall be a microprocessor-based direct wired peer to peer network system. The system shall utilize independently addressed, and microprocessor-based smoke detectors, heat detectors, and modules as described in this specification.

B. All Fire Alarm equipment shall be arranged and programmed to provide an integrated system for the early detection of fire, the notification of individual system building occupants, the automatic summoning of the local Fire Department, the override of the HVAC system operation, the override of the Digital Lighting Control system operation, and the activation of other auxiliary systems to inhibit the spread of fire and to facilitate the safe evacuation of building occupants.

C. The fire alarm equipment shall be installed in the locations shown on the project drawings.

D. The fire alarm system shall be fully supervised for the detection and reporting of the derangement of any component or circuit on the system. Signaling Line Circuits shall provide the level of performance designated as, Style 7 by UL and the NFPA. Indicating circuits shall provide the level of performance designated as Style Y by UL and the NFPA.

E. The fire alarm system shall be microprocessor driven with stored program controllers. Each panel node on the network shall use a multiple microprocessor design so that the failure of a single microprocessor will not result in a local failure. Fire alarm systems that utilize only one microprocessor for system and SLC control will not be accepted.

F. The fire alarm system shall operate from direct current having a nominal potential of 24 volts. The direct current shall be provided by a solid-state power supply connected to the building electrical system by a dedicated branch circuit in strict compliance with Articles 725 and 760 of the NEC, and these specifications.

G. A standby power supply shall automatically supply electrical energy to the system whenever the primary power supply fails to provide the minimum voltage required for proper system operation. The standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for 24 Hours in Standby and then be capable of operating the system for 5 Minutes in the alarm mode. The fire alarm system shall include a charging circuit to automatically maintain the electrical charge of the battery. The fire alarm system shall include the alarm initiating and indicating appliances and devices shown on the project drawings.

H. All Control Panel Assemblies and the connected Automatic and Manual Alarm and Field Notification Appliances shall be designed and manufactured by the same company, and shall be tested and cross-listed as compatible (UOJZ) to ensure that a fully functioning system is designed and installed.

I. Provide and install all required equipment and accessories necessary for the proper operation of the system.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Carbon monoxide detectors.
6. Automatic sprinkler system water flow.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Switch heating, ventilating, air-conditioning equipment, and lighting controls to fire-alarm mode.
5. Close smoke dampers in air ducts of designated air-conditioning duct systems.
6. Unlock secured path of egress doors.
7. Release smoke door hold open devices.
8. Record events in the system memory.
9. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. User disabling of zones or individual devices.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Edwards System Technology (EST)
2. Fire-Lite Alarms, Inc.; a Honeywell International company.
3. GE UTC Fire & Security; A United Technologies Company.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.
6. SimplexGrinnell LP.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    d. The FACP shall be listed for connection to a central-station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:
    a. One dedicated RS 485 port for remote station operation using point ID DACT.

b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.
d. One RS 232 port for VESDA HLI connection.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

H. Secure Egress Door Controls: Provide an output signal using an addressable relay to unlock secured path of egress door devices upon system notification.

I. Digital Lighting Controls: Provide output contacts using form “C” dry relay contact rated at 2 amps @ 24 Vdc to signal digital lighting controls system upon system notification.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

1.2 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Edwards System Technology (EST)
2. Fire-Lite Alarms, Inc.; a Honeywell International company.
3. GE UTC Fire & Security; A United Technologies Company.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.
6. SimplexGrinnell LP.
7. Wheelock; a brand of Eaton.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.
4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

1.3 SYSTEM SMOKE DETECTORS

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Edwards System Technology (EST)
2. Fire-Lite Alarms, Inc.; a Honeywell International company.
3. GE UTC Fire & Security; A United Technologies Company.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.
6. SimplexGrinnell LP.

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

1.4 HEAT DETECTORS

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Edwards System Technology (EST)
2. Fire-Lite Alarms, Inc.; a Honeywell International company.
3. GE UTC Fire & Security; A United Technologies Company.
4. Notifier.

5. Siemens Industry, Inc.; Fire Safety Division.
6. SimplexGrinnell LP.

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

1.5 NOTIFICATION APPLIANCES

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Edwards System Technology (EST)
2. Fire-Lite Alarms, Inc.; a Honeywell International company.
3. GE UTC Fire & Security; A United Technologies Company.
4. Notifier.
5. Siemens Industry, Inc.; Fire Safety Division.
6. SimplexGrinnell LP.

B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

C. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

E. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output:

a. 75 110 cd.
b. 75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.

3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

1.6 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

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

2.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

2.3 PATHWAYS

A. Raceways and outlet boxes: Shall comply with all other applicable Division 26 Specifications. Minimum raceway size for the fire alarm system shall be 1/2". The complete raceway system shall be grounded and bonded in accord with the requirements of the NEC. Outlet boxes shall be installed in the approximate locations indicated on the Drawings. It is the responsibility of the Contractor to ensure that the final locations of fire detectors and other initiating and indicating appliances and devices are in compliance with all applicable codes. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

D. Conductors and terminations: Shall be copper with type THHN/THWN insulation. Minimum conductor size shall be #14 AWG except that signaling line circuit (SLC) loops shall be wired with UL listed type FPL cable comprised of a jacketed and electrically shielded pair of conductors #18 AWG or larger. If stranded conductors are used they shall comply with Sections 760-16(c), 760-28(a), and 760-30(a) of the NEC.

E. All circuits shall be identified using a unique conductor insulation color throughout the system for each type of circuit.

2.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Smoke dampers in air ducts of designated HVAC duct systems.
3. Magnetically held-open doors.
4. Electronically locked doors and access gates.
5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Data communication circuits for connection to building management system.
10. Data communication circuits for connection to mass notification system.
11. Supervisory connections at fire-extinguisher locations.
12. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.

2.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

2.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

2.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

2.8 DEMONSTRATION

A. The Fire Alarm Contractor shall schedule and execute an instruction class for the Building Owner, which details the proper operation of the installed fire alarm system. The instruction shall also cover the schedule of maintenance required by NFPA 72H and any additional maintenance recommended by the system manufacturer. This instruction shall also be separately furnished to the Local Municipal Fire Department if so requested by the Local Authority Having Jurisdiction. The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation. The Fire Alarm Contractor shall provide operations manuals or any other curricula that

may enhance the instruction of the Building Owners or Local Municipal Fire Department in the operation and maintenance of the system.

END OF SECTION 28 46 21.11

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 31 20 00 – EARTH WORK

1.1 INTENT

It is the intent of these specifications to provide supplemental information to the contents of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings, either imagined or real, shall be brought to the attention of the Owner's Engineer for clarification.

1.2 DESCRIPTION OF WORK

Extent of earth work is indicated on drawings and includes but is not limited to: Preparation of subgrade for pavements; embankment for roadway; excavation and fill for site work; excavation of unsuitable material; excavation for stormwater system including ditches, channels, swales, detention areas, retention areas, etc.; excavation for Utilities: Refer to Section 9, not Work of this section.

1.3 DEFINITIONS

Excavation: Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

Embankment: Fill for roadways interior to right of way, does not include backfill of unsuitable material. Embankment may be used generically to indicate all types of fill except backfill of unsuitable material.

Subbase: A constructed bed of material laid under a road or pavement base on the natural ground surface.

Subgrade: The prepared natural ground beneath a road or pavement base.

The terms subbase and subgrade are used generically in certain instances to indicate the material beneath a road or pavement base without regard as to whether the material is naturally occurring or not. It is the intent of these specifications to make a distinction where warranted. However, on the construction plans, such a distinction may not be shown.

1.4 RELATED WORK

Section 14

1.5 QUALITY ASSURANCE

Codes and Standards: Perform all Work in compliance with applicable requirements of governing authorities having jurisdiction.

Comply with the provisions of the following codes and standards, except as otherwise shown or specified:

Standard Specifications for Road and Bridge Construction, Florida Department of Transportation, latest edition. Herein specified or shown on the plans as "Section XXX, FDOT Standard Specifications.

Testing and Inspection: Contractor will engage an independent soil testing service for quality control testing during earth work operations.

It will be the responsibility of the Contractor to coordinate all testing and inspections. Contractor shall employ, at his expense, an independent testing laboratory approved by the City Engineer. The Contractor shall notify the Owner's Engineer, testing service, and applicable agency inspectors 48 hours in advance of testing and inspections.

1.6 SUBMITTALS

Test Reports: Submit following applicable reports directly to Engineer from the testing services with copy to Contractor: Test reports on borrow material; field density test reports; optimum moisture-maximum density curves; gradation curves; bearing Test (LBR) for subbase or subgrade material; bearing Test (LBR) for base material.

1.7 JOB CONDITIONS

Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is made available for convenience of Contractor.

Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

Underground Utilities: The plans show certain features of topography, and certain underground utilities, but they do not purport to show in complete detail all such lines or obstructions. Such topography and notes on the plans were inserted from records available and are for the Contractor's convenience only and shall not be used as a basis for claims of extra compensation. Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Any damage to existing facilities resulting from the Contractor's operations shall be immediately repaired by the Contractor at no cost to the Owner.

Existing Utilities: Locate existing underground utilities in areas of Work. If utilities are to remain in place, provide adequate means of support and protection during earth work operations.

Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation.

Do not interrupt existing utilities serving facilities occupied and used by Owner or others during occupied hours, except when permitted, in writing, by Engineer and then only after acceptable temporary utility services have been provided.

Provide minimum of 48 hours notice to utility owner and receive written notice to proceed before interrupting any utility.

Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.

Protection of Persons and Property: Barricade open excavations occurring as part of this Work and post with warning lights. Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth work operations. Perform excavation by hand within drip- line of large trees to remain, and protect the root system from damage or dry out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

1.8 SOIL MATERIALS

Definitions:

Satisfactory Soil Materials: Those materials complying with AASHTO soil classification groups A-1, A-2-4, A-2-5, A-3.
Unsatisfactory Soil Materials: Those materials complying with AASHTO soil classification groups A-2-6, A-2-7, A-4, A-5, A-6, A-7, and A-8. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than three inches. Unsatisfactory materials also include manmade fills, refuse, or backfills from previous construction.

Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crush sand with less than 15% passing No. 200 sieve and a limerock bearing ratio value of at least 40.

Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1-1/2" sieve and not more than 5% passing a No. 4 sieve.

Backfill and Fill Materials: Satisfactory soil materials free of clay, rock, or gravel larger than two inches in any dimension, debris, waste, vegetable, and other deleterious matter and less than 15% passing No. 200 sieve.

1.9 EXCAVATION

General: Excavation Work includes excavation to the lines, grades, and cross- sections indicated and includes excavation of pavements and other obstructions visible on ground surface; underground structures, utilities, and other items indicated to be demolished and

removed; along with earth and other materials encountered.

Unauthorized excavation consists of removal of materials beyond indicated lines, grades, and cross-sections without specific direction of Engineer. Unauthorized excavation, as well as remedial Work directed by Engineer, shall be at Contractor's expense.

Unsuitable Materials: Where muck, rock, clay, or other material within the limits of the roadway or other Work is unsuitable in its original position, the Contractor shall excavate materials to the cross sections indicated on the plans or as directed by the Engineer. The unsuitable material, when so directed, shall be stockpiled on site at a location selected by Owner except for material containing deleterious matter larger than two inches in diameter which shall be disposed of off-site in accordance with applicable codes and regulations. The excavated area shall be backfilled with suitable material to the lines, grades, and elevations indicated on the plans in accordance with these specifications.

Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

Maintain sides and slopes of excavations in safe condition until completion of backfilling.

Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross-braces, in good, serviceable condition.

Establish requirement for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

De-watering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area. De-watering will be included in proposal cost of all items.

Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footing, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other de-watering system components necessary to convey water away from excavations.

Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

Locate and retain soil materials away from edge of excavations. Do not store within drip lines of trees indicated to remain.

Dispose of excess soil material and waste materials as herein specified.

Excavation for Structures: Excavations shall be to the lines, grades, and elevations

indicated and extending a sufficient distance from footings and foundations to permit placing and removal of concrete form work, installation of piping, other construction, and for inspection.

In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other Work.

Excavation for Pavements: Excavation under pavements shall be to the lines, grades, and elevations as indicated.

Excavation for Stormwater Systems: Excavation shall be to the lines, grades, and cross-sections indicated.

1.10 BACKFILL, FILL, AND EMBANKMENT

General: Backfill, fill, and embankment work includes fill to the lines, grades, and cross-sections indicated. Place acceptable soil material in layers to required elevations, for each area classification as contained herein.

Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Flow, strip, or break-up sloped surfaces steeper than one vertical to four horizontal so that fill material will bond with existing surface.

When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

Placement and Compaction: Place backfill and fill materials in layers not more than 12" in loose depth for material compacted by heavy compaction equipment, and not more than six inches in loose depth for material compacted by hand- operated tampers.

Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on unsuitable material unless so indicated on plans.

Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

Placing in Unstable Areas: Where the material is deposited in water or on low swampy ground that will not support the weight of hauling equipment, the fill shall be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. At the point where hauling equipment will be supported by the embankment, fill will be placed in successive layers of not more than eight inches, measured loose, for the full width of the area and to the necessary thickness.

Placing on Steep Slopes: When embankments are constructed on a hillside

sloping more than 20 degrees from the horizontal, the surface of the original ground on which the embankment is to be placed shall be plowed deeply to cut into steps, as directed, before filling is started.

Placing Outside Standard Minimum Slope: Where material is unsuitable for normal embankment construction is to be used in the embankment outside the standard minimum slope (approximately 2 to 1), such material shall be placed in layers of not more than 18 inches in thickness, measured loose. Material which is suitable for normal embankment but which is being placed outside such standard minimum slope, may also be placed in 18 inch layers.

Backfill excavations as promptly as Work permits, but not until completion of the following: Inspection, testing, approval, and recording locations of underground utilities; removal of concrete form work, no form work will be allowed to remain in place; removal of shoring and bracing and backfilling of voids with satisfactory materials; removal of trash and debris.

1.11 GRADING

General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between point where elevations are indicated, or between such points and existing grades.

Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

Finish surface free from irregular surface changes and as follows:

Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.

Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10' above or below required subgrade elevation.

Ditches, Channels, and Swales: Shape to line, grade, and cross-section, with finish surface not more than 0.10' above or below required elevations and such that no water will be impounded unless so indicated on plans.

Pavements: Shape surface of areas under pavement to line, grade, and cross- section with finish surface not more than ½" above or below required subgrade elevation.

Compaction: After grading, compact surfaces to the depth and indicated percentages of maximum or relative density for each area classification.

1.12 COMPACTION

General: Control soil compaction during construction providing minimum percentage of density specified for each layer of material for the area classification indicated below.

Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density determined in accordance with AASHTO T-180.

Drainage Structures: Unless noted otherwise on plans, compact each layer of backfill or fill material at 95% maximum density and top 12" of subgrade at 98% maximum density.

Pavement: Unless noted otherwise on plans, compact each layer of backfill or fill material at 95% maximum density. Compact the top layer as shown on the plans to the specified maximum density. The subgrade or subbase shall have a minimum Limerock Bearing Ratio (LBR) of 40. In the event that the required LBR cannot be achieved using the native or fill material, then the subgrade or subbase shall be stabilized in accordance with other Division 2 sections for stabilization.

Stormwater System: Unless noted other on plans, compact top eight inches and each layer of backfill or fill material at 95% maximum density.

Lawn or Unpaved Areas: Unless noted otherwise on plans, compact top six inches and each layer of backfill or fill material at 90% maximum density or to the density of existing soils.

Walkways, Slabs, Ditch Pavement, and Miscellaneous Structures: Unless noted otherwise on plans, compact top eight inches of subgrade and each layer of backfill or fill material at 95% maximum density.

Retaining wall footings: Compact the existing soils, prior to the placement of fill soils, until a density of 95% of the Modified Proctor (ASTM D-1557) maximum dry density is achieved to a depth of two (2) feet below compacted grade.

Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry.

Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

1.13 TESTING AND INSPECTION REQUIREMENTS

General: Testing and inspection requirements may also be contained on the plans for coordination purposes. In the event of a discrepancy between the requirements contained herein and those shown on the plans, the more stringent of the two shall apply unless directed otherwise by the Owner's Engineer.

Sub-Grade/Sub-Base: Testing and inspection of the subgrade/subbase shall include the following. Allow testing service to inspect and approve subgrade/subbase before further construction Work is performed.

Bearing Value: One limerock baring ratio test shall be performed for each material source or as material changes. Test method shall be in accordance with FDOT requirements.

Maximum Density/Optimum Moisture Content: One test shall be performed in

accordance with AASHTO T-180/ASTM D-1557 for each soil type.

Field Density and Thickness: One test and thickness measurement shall be performed for each 500 linear feet of roadway or 750 square yards of pavement with not less than three tests. Field density test shall be in accordance with AASHTO T-191/ASTM D-1556 (sand cone method) or AASHTO T-204/ASTM D- 2937 (drive cylinder method).

Fill and Backfill under Roadways and Structures: Testing and inspection shall include the following:

Maximum Density/Optimum Moisture Content: One test shall be performed in accordance with AASHTO T-180/ASTM D-1557 for each soil type.

Field Density and Thickness: One test and thickness measurement shall be performed on alternating lifts for each 500 linear feet of roadway or 750 square yards of pavement with not less than three tests per lift. Field density test shall be in accordance with AASHTO T-191/ASTM D-1556 (sand cone method) or AASHTO T-204/ASTM D-2937 (drive cylinder method).

Gradation: One gradation test shall be performed for each soil type in accordance with AASHTO M-92.

Stormwater Systems: Upon completion of earth work for a stormwater system to the lines, grades, and elevations indicated on the plans, the system shall be subject to a visual inspection prior to stabilization by vegetation.

Testing and/or inspections which must be repeated due to unsatisfactory results will be at no additional cost to the Owner.

1.14 MAINTENANCE

Protection of Graded Areas: Protect newly-graded areas from traffic and erosion. Keep free of trash and debris. Erosion control shall be by stabilizing vegetation, either permanent or temporary, placed within five days of grading.

Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape and compact to required density prior to further construction.

Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent Work and eliminate evidence of restoration to greatest extent possible.

1.15 DISPOSAL OF EXCESS AND WASTE MATERIALS

Removal to Designated Areas on Owner's Property: Transport acceptable excess excavated material to designated soil storage areas on Owner's property. Stockpile soil or spread as directed by Engineer.

Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of off Owner's property.

1.16 MEASUREMENT AND PAYMENT

General: The contract unit price for the various items shall be compensation in full for furnishing all materials, labor, equipment, tools, and incidentals necessary for completion in every detail in accordance with the plans and specifications. There will be no direct payment for clean-up and restoration of property. Payment for the Work of this section may be by areal measure, volumetric measure, per unit, or lump sum as shown on the proposal.

Areal Payment: When payment is on an aerial basis, the quantities to be paid for shall be the areal extent of Work as calculated by the method coordinates, unless the Engineer determines that another method of calculation will provide a more accurate result. The work in-place shall be measured by field survey and payment based on the calculations by the Engineer, unless otherwise specified herein. Payment shall only include Work to the lines and grades shown on the plans or directed by the Engineer.
Quantities shown on the proposal form are the Engineer's estimate of the Work in- place. Differences in the actual measure of the material and the estimated measure of material will not constitute a change in the scope of the Work or be a basis for claim by the Contractor.

Volumetric Payment: When payment is on a volumetric basis, the quantities to be paid for shall be the volume between the original and final position of the Work as calculated by the method of average end area, unless the Engineer determines that another method of calculation will provide a more accurate result. The Work in-place shall be measured by field survey and payment based on the calculations by the Engineer, unless otherwise specified herein. Payment shall only include Work to the lines and grades shown on the plans or directed by the Engineer. Quantities shown on the proposal form are the Engineer's estimate of the Work in- place. Differences in the actual measure of the material and the estimated measure of the material will not constitute a change in the scope of Work or be a basis for claim by the Contractor.

Lump Sum Payment: When payment is on a lump sum basis, Engineer estimated in-place quantities of the Work may be provided on the proposal form for the benefit of the Contractor. Differences between actual quantities and estimated quantities will not be a basis for claim by the Contractor. It shall be the responsibility of the Contractor to familiarize himself with the scope of Work and necessary requirements thereto.

Excavation and Embankment: There will be no direct payment for excavation and embankment. Full compensation for this Work will be included in the contract price for earth work.

Compaction: There will be no direct payment for compaction. Full compensation for this Work will be included in the contract price for earth work, excavation and embankment, grading, and subbase.

Unsuitable Materials: The contract unit price shall be compensation in full for the excavation and backfilling of one cubic yard, in-place. Measurement shall be as specified under Section 8.

Grading: There will be direct payment for grading. Full compensation for this Work will be included in the contract unit price for earth work.

Earth Work: The contract price, LUMP SUM, shall be compensation in full for regular excavation and embankment or fill, necessary borrow, compaction,

grading, and stabilization necessary to construct to the lines, grades, and cross- sections indicated.

SECTION 31 31 16 - TERMITE CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Chemical soil treatment.

1.02 REFERENCE STANDARDS

A. Title 7, United States Code, 136 through 136y - Federal Insecticide, Fungicide and Rodenticide Act 2019.

1.03 SUBMITTALS

A. Product Data: Indicate toxicants to be used, composition by percentage, dilution schedule, intended application rate.

B. Manufacturer's Certificate: Certify that toxicants meet or exceed specified requirements.

C. Manufacturer's Instructions: Indicate caution requirement.

D. Warranty: Submit warranty and ensure that forms have been completed in Owner's name.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing this type of work and:
   1. Having minimum of three (3) years documented experience.
   2. Licensed in the State in which the Project is located.

1.05 WARRANTY

A. Provide five year installer's warranty against damage to building caused by termites.
   1. Include coverage for repairs to building and to contents damaged due to building damage. Repair damage and, if required, re-treat.
   2. Inspect annually and report in writing to Owner. Provide inspection service for 12 months from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 CHEMICAL SOIL TREATMENT

A. Toxicant Chemical: EPA Title 7, United States Code, 136 through 136y approved; synthetically color dyed to permit visual identification of treated soil.

B. Diluent: Recommended by toxicant manufacturer.

C. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Bayer Environmental Science Corp; Premise series.
   2. FMC Professional Solutions; Dragnet SFR or Talstar series.
   3. Syngenta Professional Products; Demon series.

D. Mixes: Mix toxicant to manufacturer's instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

B. Verify final grading is complete.

3.02 APPLICATION - CHEMICAL TREATMENT

A. Comply with requirements of U.S. EPA and applicable state and local codes.

B. Spray apply toxicant in accordance with manufacturer's instructions.

C. Apply toxicant at following locations:
   1. Under Slabs-on-Grade.
   2. At Both Sides of Foundation Surface.

D. Under slabs, apply toxicant immediately prior to installation of vapor barrier.

E. At foundation walls, apply toxicant immediately prior to finish grading work outside foundations.

F. Apply extra treatment to structure penetration surfaces such as pipe or ducts, and soil penetrations such as grounding rods or posts.

G. Re-treat disturbed treated soil with same toxicant as original treatment.

H. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.03 INSTALLATION - SITE-APPLIED TERMITICIDE

A. Comply with manufacturer's written instructions.

END OF SECTION 31 31 16

SECTION 32 12 16 - ASPHALTIC CONCRETE PAVEMENT

1.1 INTENT

It is the intent of these specifications to provide supplemental information to the contents of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements, which are not applicable to the project. Discrepancies between these specifications and the construction drawings either imagined or real, shall be brought to the attention of the Owner's Engineer for clarification.

1.2 DESCRIPTION OF WORK

Extent of asphalt concrete paving work is shown on the drawings and includes construction of the base course.

Subbase is specified in earthwork section.

1.3 QUALITY ASSURANCE

Codes and Standards: Perform excavating work in compliance with applicable requirements of governing authorities having jurisdiction.

Comply with the provisions of the following codes and standards, except as otherwise shown or specified.

"Standard Specifications for Road and Bridge Construction" Florida Department of Transportation, latest edition. Herein specified or as shown on the plans as "Section XXX, FDOT Standard Specifications"

Testing and inspection: Contractor will engage independent soil testing service for quality control testing during earthwork and asphaltic concrete pavement operations.

It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner's Engineer, testing service and applicable agency inspectors 48 hours in advance of testing and inspections.

1.4 SUBMITTAL

Material Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements. Contractor shall employ, at his expense, an independent testing laboratory approved by the City Engineer.

Test Reports-Paving: Submit following reports directly to Engineer from the testing services with copy to Contractor:

Base Material: Bearing Test (LBR); Optimum Moisture - Maximum Density; Gradation and Atterberg Limits; Field Density and Thickness

Base Material (Asphalt Base Course): Marshall Stability; Field Density and Thickness

Asphalt: Material Quality; Bitumen Content and Gradation; Field Density and Thickness; Aggregate Certificate; Marshall Stability and Density

1.5 LIMEROCK BASE

General: Limerock material for use in the construction of base shall be in accordance with Section 911, FDOT Standard specifications. At the Contractor's opinion limerock of either the Miami or Ocala formation may be used, but limerock of only one formation may be used.

1.6 ASPHALT

334-1.1 General: Construct a Superpave Asphalt Concrete pavement with the type of mixture specified in the Contract, or when offered as alternates, as selected. Superpave mixes are identified as Type SP-9.5, Type SP-12.5 or Type SP-19.0.

Meet the requirements of Section 320 for plant and equipment. Meet the general construction requirements of Section 330, except as modified herein, including the provision for Quality Control Plans and Quality Control Systems as specified in Section 105.

334-1.2 Traffic Levels: The requirements for Type SP Asphalt Concrete mixtures are based on the design traffic level of the project, expressed in 18,000 pound Equivalent Single Axle Loads (ESAL's). The five traffic levels are as shown in Table 334-1.

Table 334-1
Superpave Traffic Levels

Traffic Level	Traffic Level ($1x10^6$ ESAL's)
A	<0.3
B	0.3 to <3
C	3 to <10
D	10 to <30
E	≥30

The traffic level(s) for the project are as specified in the Contract. A Type SP mix one traffic level higher than the traffic level specified in the Contract may be substituted, at no cost to the Department (i.e. Traffic Level B may be substituted for Traffic Level A, etc.).

334-1.3 Gradation Classification: The Superpave mixes are classified as either coarse or fine, depending on the overall gradation of the mixture. Coarse and fine mixes are defined in 334-3.2.2.

The equivalent AASHTO nominal maximum aggregate size Superpave mixes are as follows:

Type SP-9.5.....9.5 mm
Type SP-12.5.....12.5 mm
Type SP-19.0.....19.0 mm

334-1.4 Thickness: The total thickness of the Type SP asphalt layer(s) will be the plan thickness as shown in the Contract Documents. Before paving, propose a thickness for each individual layer meeting the requirements of this specification, which when combined with other layers (as applicable) will equal the plan thickness. For construction purposes, the plan thickness and individual layer thickness will be converted to spread rate based on the maximum specific gravity of the asphalt mix being used, as well as the minimum density level, as shown in the following equation:

Spread rate (lbs/yd^2) = $t \times G_{mm} \times 43.3$

Where: t = Thickness (in.) (Plan thickness or individual layer thickness)
G_{mm} = Maximum specific gravity from the verified mix design

The weight of the mixture shall be determined as provided in 320-3.2. For target purposes only, spread rate calculations should be rounded to the nearest whole number.

Note: Plan quantities are based on a G_{mm} of 2.540, corresponding to a spread rate of 110 lbs/yd^2-in. Pay quantities will be based on the actual maximum specific gravity of the mix being used.

334-1.4.1 Layer Thicknesses - Fine Mixes: The allowable layer thicknesses for fine Type SP Asphalt Concrete mixtures are as follows:

Type SP-9.5 .....1 - 1 1/2 inches
Type SP-12.5 .....1 1/2 - 2 1/2 inches
Type SP-19.0 .....2 - 3 inches

In addition to the minimum and maximum thickness requirements, the following restrictions are placed on fine mixes when used as a structural course:

Type SP-9.5 - Limited to the top two structural layers, two layers maximum.
Type SP-9.5 – May not be used on Traffic Level D and E applications.
Type SP-19.0 - May not be used in the final (top) structural layer.

334-1.4.2 Layer Thicknesses - Coarse Mixes: The allowable layer thicknesses for coarse Type SP Asphalt Concrete mixtures are as follows:

Type SP-9.5 .....1 1/2 - 2 inches
Type SP-12.5 .....2 - 3 inches
Type SP-19.0 .....3 - 3 1/2 inches

In addition to the minimum and maximum thickness requirements, the following restrictions are placed on coarse mixes when used as a structural course:

Type SP-19.0 - May not be used in the final (top) structural layer.

334-1.4.3 Additional Requirements: The following requirements also apply to coarse and fine Type SP Asphalt Concrete mixtures:

1. A minimum 1 1/2 inch initial lift is required over an Asphalt Rubber Membrane Interlayer (ARMI).
2. When construction includes the paving of adjacent shoulders (≤5 feet wide), the layer thickness for the upper pavement layer and shoulder must be the same and paved in a single pass, unless called for differently in the Contract Documents.
3. All overbuild layers must be fine Type SP Asphalt Concrete designed at the traffic level as stated in the Contract. Use the minimum and maximum layer thicknesses as specified above unless called for differently in the Contract Documents. On variable thickness overbuild layers, the minimum allowable thickness may be reduced by 1/2 inch, and the maximum allowable thickness may be increased 1/2 inch, unless called for differently in the Contract Documents.

1.9 ASPHALT-AGGREGATE MIXTURE

334-3.1 General: Compose the asphalt mixture using a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and asphalt binder material. Size, grade and combine the aggregate fractions to meet the grading and physical properties of the mix design. Aggregates from various sources may be combined.

334-3.2 Mix Design:

334-3.2.1 General: Design the asphalt mixture in accordance with AASHTO R35-04, except as noted herein. Prior to the production of any asphalt mixture, submit the proposed mix design with supporting test data indicating compliance with all mix design criteria to the Engineer. For Traffic Level B through E mix designs, include representative samples of all component materials, including asphalt binder. Allow the State Materials Engineer a maximum of four weeks to either conditionally verify or reject the mix as designed.

Do not use more than three mix designs per nominal maximum aggregate size per traffic level per binder grade per contract year. Exceeding this limitation will result in a maximum Composite Pay Factor of 1.00 as defined in 334-8.2 for all designs used beyond this limit.

Warm mix technologies (additives, foaming techniques, etc.) listed on the Department's website may be used in the production of the mix. The URL for obtaining this information, if available, is:
http://www.dot.state.fl.us/Specificationsoffice/implemented/URLinSpecs/files/WarmMixAsphalt.pdf .
The Engineer will consider any marked variations from original test data for a mix design or any evidence of inadequate field performance of a mix design as sufficient evidence that the properties of the mix design have changed, and the Engineer will no longer allow the use of the mix design.

334-3.2.2 Mixture Gradation Requirements: Combine the coarse and fine aggregate in proportions that will produce an asphalt mixture meeting all of the requirements defined

in this specification and conform to the gradation requirements at design as defined in AASHTO M323-07, Table 3. Aggregates from various sources may be combined.

334-3.2.2.1 Mixture Gradation Classification: Plot the combined mixture gradation on an FHWA 0.45 Power Gradation Chart. Include the Control Points from AASHTO M323-07, Table-3, as well as the Primary Control Sieve (PCS) Control Point from AASHTO M323-07, Table 4. Coarse mixes are defined as having a combined aggregate gradation that passes below the primary control sieve control point and below the maximum density line for all sieve sizes smaller than the primary control sieve. Fine mixes are defined as having a gradation that passes above the primary control sieve control point and above the maximum density line for all sieve sizes smaller than the primary control sieve and larger than the #100 sieve. Use a fine mix for Traffic Levels A through C; use either a coarse mix or fine mix for Traffic Levels D and E.

334-3.2.3 Aggregate Consensus Properties: For Traffic Level C through E mixtures, meet the following consensus properties at design for the aggregate blend.

Aggregate consensus properties do not apply to Traffic Level A and B mixtures.

334-3.2.3.1 Coarse Aggregate Angularity: When tested in accordance with ASTM D 5821, meet the percentage of fractured faces requirements specified in AASHTO M 323-07, Table 5.

334-3.2.3.2 Fine Aggregate Angularity: When tested in accordance with AASHTO T 304, Method A, meet the uncompacted void content of fine aggregate specified in AASHTO M 323-07, Table 5.

334-3.2.3.3 Flat and Elongated Particles: When tested in accordance with ASTM D 4791, (with the exception that the material passing the 3/8 inch sieve and retained on the No. 4 sieve shall be included), meet the requirements specified in AASHTO M 323-07, Table 5. Measure the aggregate using the ratio of 5:1, comparing the length (longest dimension) to the thickness (shortest dimension) of the aggregate particles.

334-3.2.3.4 Sand Equivalent: When tested in accordance with AASHTO T 176, meet the sand equivalent requirements specified in AASHTO M 323-07, Table 5.

334-3.2.4 Gyratory Compaction: Compact the design mixture in accordance with AASHTO T 312-08, with the following exception: use the number of gyrations at N_{design} as defined in Table 334-3. Measure the inside diameter of gyratory molds in accordance with FM 5-585.

Table 334-3
Gyratory Compaction Requirements

Traffic Level	N_{design} Number of Gyrations
A	50
B	65
C	75
D	100
E	100

334-3.2.5 Design Criteria: Meet the requirements for nominal maximum aggregate size as defined in AASHTO M323-07, as well as for relative density, VMA, VFA, and dust-to-binder ratio as specified in AASHTO M323-07, Table 6. Use a dust-to-binder ratio of 0.8 to 1.6 for coarse mixes. $N_{maximum}$ requirements are not applicable for Traffic Level A and B mixtures.

334-3.2.6 Moisture Susceptibility:

1. For Traffic Level A and B mixtures, use a liquid anti-strip additive, which is on the Department's Qualified Products List, at a rate of 0.5% by weight of the asphalt binder. Other rates of anti-strip additive may be used upon approval of the Engineer.

2. For Traffic Level C through E mixtures, test 4 inch specimens in accordance with FM 1-T 283. Provide a mixture having a retained tensile strength ratio of at least 0.80 and a minimum tensile strength (unconditioned) of 100 psi. If necessary, add a liquid anti-stripping agent, which is on the Department's Qualified Products List and/or hydrated lime (meeting the requirements of Section 337) in order to meet these criteria.

334-3.2.7 Additional Information: In addition to the requirements listed above, provide the following information with each proposed mix design submitted for verification:

1. The design traffic level and the design number of gyrations (N_{design}).
2. The source and description of the materials to be used.
3. The DOT source number and the DOT product code of the aggregate components furnished from a DOT approved source.
4. The gradation and proportions of the raw materials as intended to be combined in the paving mixture. The gradation of the component materials shall be representative of the material at the time of use. Compensate for any change in aggregate gradation caused by handling and processing as necessary.
5. A single percentage of the combined mineral aggregate passing each specified sieve. Degradation of the aggregate due to processing (particularly material passing the No. 200 sieve) should be accounted for and identified.
6. The bulk specific gravity (G_{sb}) value for each individual aggregate and RAP component, as identified in the Department's aggregate control program.
7. A single percentage of asphalt binder by weight of total mix intended to be incorporated in the completed mixture, shown to the nearest 0.1 percent.
8. A target temperature for the mixture at the plant (mixing temperature) and a target temperature for the mixture at the roadway (compaction temperature) in accordance with 320-6.3. Do not exceed a target temperature of 330°F for PG 76-22 asphalt binders, 320°F for ARB-12 asphalt binders, and 315°F for ARB-5 and unmodified asphalt binders.
9. Provide the physical properties achieved at four different asphalt binder contents. One of which shall be at the optimum asphalt content, and must conform to all specified physical requirements.
10. The name of the CTQP Qualified Mix Designer.
11. The ignition oven calibration factor.
12. The warm mix technology, if used.

334-3.3 Mix Design Revisions: During production, the Contractor may request a target value revision to a mix design, subject to meeting the following requirements: (1) the target change falls within the limits defined in Table 334-4, (2) appropriate data exists demonstrating that the mix complies with production air voids specification criteria, and (3) the mixture gradation meets the basic gradation requirements defined in 334-3.2.2.

Table 334-4
Limits for Potential Adjustments to Mix Design Target Values

Characteristic	Limit from Original Mix Design
No. 8 sieve and Coarser	± 5.0 percent
No. 16 sieve	± 4.0 percent
No. 30 sieve	± 4.0 percent
No. 50 sieve	± 3.0 percent
No. 100 sieve	± 3.0 percent
No. 200 sieve	± 1.0 percent
Asphalt Binder Content (1)	± 0.3 percent
Each Component of Aggregate Blend (2)	± 5.0 percent

(1) Reductions to the asphalt binder content will not be permitted if the VMA during production is lower than 1.0 percent below the design criteria.
(2) Revisions to FC-5 mixtures to be determined by the Engineer.

Submit all requests for revisions to mix designs, along with supporting documentation, to the Engineer. In order to expedite the revision process, the request for revision or discussions on the possibility of a revision may be made verbally, but must be followed up by a written request. The verified mix design will remain in effect until the Engineer authorizes a change. In no case will the effective date of the revision be established earlier than the date of the first communication between the Contractor and the Engineer regarding the revision.

A new design mix will be required if aggregate sources change, or for any substitution of an aggregate product with a different aggregate code, unless approved by the Engineer.

1.10 BASE

General: Before any base course material is placed, the Contractor shall prepare and condition the finished roadbed as specified in Earthwork section. No material shall be placed on a soft, muddy or frozen coarse. The thickness of the finished base shall be within ½ inch and the finished surface shall be within 1/4 inch of lines, grades and cross sections indicated in the plans. It shall be the responsibility of the Contractor to maintain the base in the required condition until the surface course is applied.

Sand-Clay Base: Sand-Clay Base shall be constructed in accordance with section 240, FDOT Standard Specifications with the following modifications and specific requirements. The base shall be compacted in layers not less than 4 inches and not more than six inches of compacted thickness. As soon as proper conditions are attained the material shall be compacted to a density of not less than 98% of the maximum density as determined by AASHTO T 180, unless noted otherwise on the drawings. The prime coat shall be applied only when the base meets the specified density requirements and the moisture content in

the top half of the base does not exceed 90% of the optimum moisture for the base material. Moisture checks shall be made immediately prior to the application of the surface at locations designated by the Owner's Geotechnical Engineer.

Sand-Asphalt Base: Sand-Asphalt Base shall be constructed in accordance with Sections 280 and 330, FDOT Standard Specifications with the following modifications and specific requirements. The maximum compacted thickness of each layer shall not exceed 2 inches and the base shall be placed in layers of equal thickness. Placement of layers of uneven thickness will not be allowed. A tack coat will not be required between successive layers if placed on the same day and the initial layer has not been contaminated by sand, dust, etc.

Prime Coat: The surface to be primed shall be clean and the moisture content of the base shall not exceed 90% of the optimum moisture. The temperature of the material shall be between 100 degrees and 150 degrees Fahrenheit, which will insure uniform distribution. The material shall be applied by means of a pressure distributor at a rate of not less than 0.15 gallons per square yard for Sand-Clay and Shell bases. The primed base shall be covered by a light uniform application of sand or screening.

1.12 TESTING AND INSPECTION REQUIREMENTS

Base: Testing and inspection of the base, except bituminous base, shall include the following. The base shall have been accepted prior to placement of pavement unless waived by the Owner's Engineer.

Bearing Value: One limerock bearing ratio test shall be performed for each material source or as material changes. Test method shall be in accordance with FDOT requirements.

Maximum Density/Optimum Moisture Content: One test shall be performed in accordance with AASHTO T-180/ASTM D-1557 for each material source or as material changes.

Field Density and Thickness: One test and thickness measurement shall be performed for each 500 linear feet of roadway or 750 square yards of pavement with not less than three tests. Field density test shall be in accordance with AASHTO T-191/ASTM D-1556 (sand cone method) or AASHTO T-240/ASTM D-2937 (drive cylinder method).

Gradation and Atterberg Limits: One per material source or as material changes in accordance with AASHTO T-27, T-89, T-90/ASTM C-136, D-423, D-424.

Bituminous Base: Testing and inspection shall include the following:

Field Density and Thickness: One test and thickness measurement shall be performed for each 500 linear feet of roadway or 750 square yards of pavement with not less than three tests. Tests shall be staggered left, right and on centerline. Field density test shall be in accordance with ASTM D-2950.

Marshall Stability and Density: One per source or as material changes in accordance with Section 331, FDOT Standard Specifications.

Asphalt: Testing and inspection of the asphalt shall include the following:

334-5.1 General: The mixture will be accepted at the plant with respect to gradation (P_{-8} and P_{-200}), asphalt content (P_b), and volumetrics (volumetrics is defined as air voids at N_{design}). The mixture will be accepted on the roadway with respect to density of roadway cores. Acceptance will be on a LOT-by-LOT basis (for each mix design) based on tests of random samples obtained within each sublot taken at a frequency of one set of samples per sublot. A roadway LOT and a plant production LOT shall be the same. Acceptance of the mixture will be based on Contractor Quality Control test results that have been verified by the Department.

334-5.1.1 Sampling and Testing Requirements: Obtain the samples in accordance with FM 1-T 168. Obtain samples at the plant of a sufficient quantity to be split into three smaller samples; one for Quality Control, one for Verification and one for Resolution testing; each sample at approximately 35 pounds. The split samples for Verification testing and Resolution testing shall be reduced in size and stored in three boxes each. The approximate size of each box must be 12 inches x 8 inches x 4 inches. Provide, label and safely store sample boxes in a manner agreed upon by the Engineer for future testing.

The asphalt content of the mixture will be determined in accordance with FM 5-563. In the event the FM 5-563 ignition oven goes out of service during production, the Contractor may elect to use a replacement oven at another location for no more than 72 hours while the oven is being repaired. The gradation of the recovered aggregate will be determined in accordance with FM 1-T 030. Volumetric testing will be in accordance with AASHTO T 312-08 and FM 1-T 209. Measure the inside diameter of gyratory molds in accordance with FM 5-585. Prior to testing volumetric samples, condition the test-sized sample for one hour plus or minus five minutes at the target roadway compaction temperature in a shallow, flat pan, such that the mixture temperature at the end of the one hour conditioning period is within plus or minus 20°F of the roadway compaction temperature. Test for roadway density in accordance with FM 1-T 166.

334-5.1.2 Acceptance Testing Exceptions: When the total combined quantity of hot mix asphalt for the project, as indicated in the plans for Type SP and Type FC mixtures only, is less than 2000 tons, the Engineer will accept the mix on the basis of visual inspection. The Engineer may require the Contractor to run process control tests for informational purposes, as defined in 334-4, or may run independent verification tests to determine the acceptability of the material.

Where density testing for acceptance is not required, compact these courses (with the exception of open-graded friction courses) in accordance with the rolling procedure (equipment and pattern) as approved by the Engineer or with Standard Rolling Procedure as specified in 330-7.2. In the event that the rolling procedure deviates from the procedure approved by the Engineer, or the Standard Rolling Procedure, placement of the mix shall be stopped.

334-5.4 Quality Control Sampling and Testing: Obtain all samples randomly as directed by the Engineer.

Should the Engineer determine that the Quality Control requirements are not being met or that unsatisfactory results are being obtained, or should any instances of falsification

of test data occur, approval of the Contractor's Quality Control Plan will be suspended and production will be stopped.

334-5.4.1 Lost or Missing Verification/Resolution Samples: In the event that any of the Verification and/or Resolution samples that are in the custody of the Contractor are lost, damaged, destroyed, or are otherwise unavailable for testing, the minimum possible pay factor for each quality characteristic as described in 334-8.2 will be applied to the entire LOT in question, unless called for otherwise by the Engineer. Specifically, if the LOT in question has more than two sublots, the pay factor for each quality characteristic will be 0.55. If the LOT has two or less sublots, the pay factor for each quality characteristic will be 0.80. In either event, the material in question will also be evaluated in accordance with 334-5.9.5.

If any of the Verification and/or Resolution samples that are in the custody of the Department are lost, damaged, destroyed or are otherwise unavailable for testing, the corresponding Quality Control test result will be considered verified, and payment will be based upon the Contractor's data.

334-5.4.2 Plant Sampling and Testing Requirements: Obtain one random sample of mix per sublot in accordance with 334-5.1.1 as directed by the Engineer. Test the Quality Control split sample for gradation, asphalt binder content and volumetrics in accordance with 334-5.1.1. Complete all Quality Control testing within one working day from the time the samples were obtained.

334-5.4.3 Roadway Sampling and Testing Requirements: Obtain five 6 inch diameter roadway cores within 24 hours of placement at random locations as directed by the Engineer within each sublot. Test these Quality Control samples for density (G_{mb}) in accordance with 334-5.1.1. In situations where it is impractical to cut five cores per sublot, obtain a minimum of three cores per sublot at random locations as identified by the Engineer. Do not obtain cores any closer than 12 inches from an unsupported edge. Maintain traffic during the coring operation; core the roadway, patch the core holes (within three days of coring); and trim the cores to the proper thickness prior to density testing.

Density for the sublot shall be based on the average value for the cores cut from the sublot with the target density being the maximum specific gravity (G_{mm}) of the sublot. Once the average density of a sublot has been determined, do not retest the samples unless approved by the Engineer. Ensure proper handling and storage of all cores until the LOT in question has been accepted.

334-5.4.4 Individual Test Tolerances for Quality Control Testing: Terminate the LOT if any of the following Quality Control failures occur:

1. An individual test result of a sublot for air voids does not meet the requirements of Table 334-5,
2. The average sublot density for coarse mixes does not meet the requirements of Table 334-5,
3. Two consecutive test results for gradation (P_{-200}) do not meet the requirements of Table 334-5
4. Two consecutive test results for asphalt binder content do not meet the requirements of Table 334-5,

5. The average sublot density for two consecutive sublots for fine mixes does not meet the requirements of Table 334-5,
6. Two core densities for coarse mixes within a sublot are less than 91.00% of G_{mm}.

When a LOT is terminated due to a QC failure, stop production of the mixture until the problem is resolved to the satisfaction of the Quality Control Manager(s) and/or Asphalt Plant Level II technician(s) responsible for the decision to resume production after a quality control failure, as identified in 105-8.6.4. In the event that it can be demonstrated that the problem can immediately be or already has been resolved, it will not be necessary to stop production. When a LOT is terminated, make all necessary changes to correct the problem. Do not resume production until appropriate corrections have been made. Inform the Engineer of the problem and corrections made to correct the problem. After resuming production, sample and test the material to verify that the changes have corrected the problem. Summarize this information and provide it to the Engineer prior to the end of the work shift when production resumes.

In the event that a Quality Control failure is not addressed as defined above, the Engineer's approval will be required prior to resuming production after any future Quality Control failures.

Address any material represented by a failing test result in accordance with 334-5.9.5. Any LOT terminated under this Subarticle will be limited to a maximum Pay Factor of 1.00 (as defined in 334-8.2) for each quality characteristic.

In the event that a G_{mm} test result differs by more than 0.040 from the mix design G_{mm}, investigate the cause(s) of the discrepancy and report the findings and proposed actions to the Engineer.

Table 334-5
Master Production Range

Characteristic	Tolerance (1)
Asphalt Binder Content (percent)	Target ±0.55
Passing No. 200 Sieve (percent)	Target ±1.50
Air Voids (percent) Coarse Graded	2.00 - 6.00
Air Voids (percent) Fine Graded	2.30 – 6.00
Density (percent G_{mm}) (2)	
Coarse Graded (minimum)	93.00
Fine Graded (minimum)	90.00

(1) Tolerances for sample size of n = 1 from the verified mix design
(2) Based on an average of 5 randomly located cores

334-5.5 Verification Testing: In order to determine the validity of the Contractor's Quality Control test results prior to their use in the Acceptance decision, the Engineer will run verification tests.

334-5.5.1 Plant Testing: At the completion of each LOT, the Engineer will test a minimum of one Verification split sample randomly selected from the LOT. Results of the testing and analysis for the LOT will be made available to the Contractor within one

working day from the time the LOT is completed. Verification samples shall be reheated at the target roadway compaction temperature for 1 1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1.

The Verification test results will be compared with the Quality Control test results based on the between-laboratory precision values shown in Table 334-6.

Table 334-6
Between-Laboratory Precision Values

Property	Maximum Difference
G_{mm}	0.016
G_{mb} (gyratory compacted samples)	0.022
Gmb (roadway cores – fine graded mixture)	0.015
Gmb (roadway cores – coarse graded mixture)	0.018
P_b	0.44 percent
P_{-200}	FM 1-T 030 (Figure 2)
P_{-8}	FM 1-T 030 (Figure 2)

If all of the specified mix characteristics compare favorably, then the LOT will be accepted, with payment based on the Contractor's Quality Control test data for the LOT.

If any of the results do not compare favorably, then the Resolution samples from the LOT will be sent to the Resolution laboratory for testing, as described in 334-5.6.

334-5.5.2 Roadway Testing: At the completion of each LOT, the Engineer will determine the density (G_{mb}) of each core (previously tested by Quality Control) as described in 334-5.1.1 from the same sublot as the Plant samples. For situations where roadway density is not required for the random sublot chosen, then another sublot shall be randomly chosen for roadway density cores only. Results of the testing and analysis for the LOT will be made available to the Contractor within one working day from the time the LOT is completed.

The individual Verification test results will be compared with individual Quality Control test results by the Engineer based on the between-laboratory precision values given in Table 334-6.

If each of the core test results compare favorably, then the LOT will be accepted with respect to density, with payment based on the Contractor's Quality Control test data for the LOT.

If any of the results do not compare favorably, then the core samples from the LOT will be sent to the Resolution laboratory for testing as specified in 334-5.6.

334-5.6 Resolution System:

334-5.6.1 Plant Samples: In the event of an unfavorable comparison between the Contractor's Quality Control test results and the Engineer's Verification test results on any of the properties identified in Table 334-6, the Resolution laboratory will test all of the split samples from the LOT for only the property (or properties) in question.

Resolution samples shall be reheated at the target roadway compaction temperature for 1-1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1.

334-5.6.2 Roadway Samples: In the event of an unfavorable comparison between the Contractor's Quality Control test data and the Engineer's Verification test data on the density results, the Resolution laboratory will test all of the cores from the LOT. Testing will be as described in 334-5.1.1. Any damaged roadway cores will not be included in the evaluation; replace damaged cores with additional cores at the direction of the Engineer.

334-5.6.3 Resolution Determination: The Resolution test results (for the property or properties in question) will be compared with the Quality Control test results based on the between-laboratory precision values shown in Table 334-6.

If the Resolution laboratory results compare favorably with all of the Quality Control results, then acceptance and payment for the LOT will be based on the Quality Control results, and the Department will bear the costs associated with Resolution testing. No additional compensation, either monetary or time, will be made for the impacts of any such testing.

If the Resolution laboratory results do not compare favorably with all of the Quality Control results, then acceptance and payment for the LOT will be based on the Resolution test data for the LOT, and the costs of the Resolution testing will be deducted from monthly estimates. No additional time will be granted for the impacts of any such testing. In addition, in the event that the application of the Resolution test data results in a failure to meet the requirements of Table 334-5, address any material represented by the failing test result in accordance with 334-5.9.5.

In the event of an unfavorable comparison between the Resolution test results and Quality Control test results, make the necessary adjustments to assure that future comparisons are favorable.

334-5.7 Independent Verification Testing:

334-5.7.1 Plant: The Contractor shall provide sample boxes and take samples as directed by the Engineer for Independent Verification testing. Obtain enough material for three complete sets of tests (two samples for Independent Verification testing by the Engineer and one sample for testing by the Contractor). If agreed upon by both the Engineer and the Contractor, only one sample for Independent Verification testing by the Engineer may be obtained. Independent Verification samples will be reheated at the target roadway compaction temperature for 1-1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. The Contractor's split sample, if tested immediately after sampling, shall be reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. If the Contractor's sample is not tested immediately after sampling, then the sample shall be reheated at the target roadway compaction temperature for 1-1/2 hours plus or minus 5 minutes, reduced to the appropriate testing size, and conditioned and tested as described in 334-5.1.1. The Contractor's test results shall be provided to the Engineer within one working day from the time the sample was obtained.

If any of the Independent Verification test results do not meet the requirements of Table 334-5, then a comparison of the Independent Verification test results and the Contractor's test results, if available, will be made. If a comparison of the Independent Verification test results and the Contractor's test results meets the precision values of Table 334-6 for the material properties in question, or if the Contractor's test results are not available, then the Independent Verification test results are considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

If a comparison of the Independent Verification test results and the Contractor's test results does not meet the precision values of Table 334-6 for the material properties in question, then the second Independent Verification sample shall be tested by the Engineer for the material properties in question. If a comparison between the first and second Independent Verification test results does not meet the precision values of Table 334-6 for the material properties in question, then the first Independent Verification test results are considered unverified for the material properties in question and no action shall be taken.

If a comparison between the first and second Independent Verification test results meets the precision values of Table 334-6 for the material properties in question, then the first Independent Verification sample is considered verified and the Contractor shall cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5. The Engineer has the option to use the Independent Verification sample for comparison testing as specified in 334-6.

334-5.7.2 Roadway: Obtain five 6 inch diameter roadway cores within 24 hours of placement, as directed by the Engineer, for Independent Verification testing. In situations where it is impractical to cut five cores per sublot, obtain a minimum of three cores per sublot at random locations, as identified by the Engineer. These independent cores will be obtained from the same LOTs and sublots as the Independent Verification Plant samples, or as directed by the Engineer. The density of these cores will be obtained as described in 334-5.1.1. If the average of the results for the sublot does not meet the requirements of Table 334-5 for density, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Address any material represented by the failing test results in accordance with 334-5.9.5.

334-5.8 Surface Tolerance: The asphalt mixture will be accepted on the roadway with respect to surface tolerance in accordance with the applicable requirements of 330-9.

334-5.9 Minimum Acceptable Quality Levels:

334-5.9.1 Pay Factors Below 0.90: In the event that an individual pay factor for any quality characteristic of a LOT falls below 0.90, take steps to correct the situation and

report the actions to the Engineer. In the event that the pay factor for the same quality characteristic for two consecutive LOTs is below 0.90, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.2 Composite Pay Factors Less Than 0.90 and Greater Than or Equal to 0.80: If the composite pay factor for the LOT is less than 0.90 and greater than or equal to 0.80, cease production of the asphalt mixture until the problem is adequately resolved (to the satisfaction of the Engineer), unless it can be demonstrated to the satisfaction of the Engineer that the problem can immediately be (or already has been) resolved. Actions taken must be approved by the Engineer before production resumes.

334-5.9.3 Composite Pay Factors Less Than 0.80 and Greater Than or Equal to 0.75: If the composite pay factor for the LOT is less than 0.80 and greater than or equal to 0.75, address the defective material in accordance with 334-5.9.5.

334-5.9.4 Composite Pay Factors Less Than 0.75: If the composite pay factor for the LOT is less than 0.75, remove and replace the defective LOT at no cost to the Department, or as approved by the Engineer.

334-5.9.5 Defective Material: Assume responsibility for removing and replacing all defective material placed on the project, at no cost to the Department.

As an exception to the above and upon approval of the Engineer, obtain an engineering analysis by an independent laboratory (as approved by the Engineer) to determine the disposition of the material. The engineering analysis must be signed and sealed by a Professional Engineer licensed in the State of Florida.

The Engineer may determine that an engineering analysis is not necessary or may perform an engineering analysis to determine the disposition of the material. Any material that remains in place will be accepted with a composite pay factor as determined by 334-8, or as determined by the Engineer.

If the defective material is due to a gradation, asphalt binder content or density failure, upon approval of the Engineer the Contractor may perform delineation tests on roadway cores in lieu of an engineering analysis to determine the limits of the defective material that requires removal and replacement. Prior to any delineation testing, all sampling locations shall be approved by the Engineer. All delineation sampling and testing shall be monitored and verified by the Engineer. The minimum limit of removal of defective material is fifty-feet either side of the failed sample. For materials that are defective due to air voids, an engineering analysis is required.

When evaluating defective material by engineering analysis or delineation testing, at a minimum, evaluate all material located between passing Quality Control, Process Control or Independent Verification test results. Exceptions to this requirement shall be approved by the Engineer.

334-6 Comparison Testing.

At the start of the project (unless waived by the Engineer) and at other times as determined necessary by the Engineer, provide split samples for comparison testing with the Engineer. The purpose of these tests is to verify that the testing equipment is functioning properly and that the testing procedures are being performed correctly. In the event that the Engineer determines that there is a problem with the Contractor's testing equipment and/or testing procedures, immediately correct the problem to the Engineer's satisfaction. In the event that the problem is not immediately corrected, cease production of the asphalt mixture until the problem is adequately resolved to the satisfaction of the Engineer.

If so agreed to by both the Contractor and the Engineer, the split sample used for comparison testing may also be used for the Quality Control sample. The split sample used for comparison testing will also meet the requirements for Independent Verification Testing described in 334-5.7.

.

1.13 MEASUREMENT AND PAYMENT

General: The contract unit price for the various items shall be compensation in full for finishing all materials, labor, traffic marking, equipment, tools and incidentals necessary for the installation of the item complete in every detail in accordance with the plans and specifications. There will be no direct payment for clean-up and restoration of property. Payment for the Work of this section may be by areal measure or lump sum as shown on the proposal.

Areal Payment: When payment is on an areal basis the quantities to be paid for shall be the areal extent of Work as calculated by the method coordinates, unless the Engineer determines that another method of calculation will provide a more accurate result. The Work in-place shall be measured by field survey and payment based on the calculations by the Engineer, unless otherwise specified herein. Payment shall only include Work to the lines and grades shown on the plans or directed by the Engineer. Quantities shown on the proposal form are the Engineer's estimate of the Work in-place. Differences in the actual measure of the material and the estimated measure of the material will not constitute a change in the scope of the Work or be a basis for claim by the Contractor.

Lump Sum Payment: When payment is on a lump sum basis, Engineer estimated in-place quantities of the Work may be provided on the proposal form for the benefit of the Contractor. Differences between actual quantities and estimated quantities will not be a basis for claim by the Contractor. It shall be the responsibility of the Contractor to familiarize himself with the scope of Work and necessary requirements thereto.

Compaction: There will be no direct payment for compaction. Full compensation for this work will be included in the contract price for base and/or surface course.

Base: The contract unit price for the various types and thickness shall be compensation in full for one square yard. Measurement shall be the number of square yards, computed by the Engineer, to construct the base in accordance with the plans.
Prime Coat: There will be no direct payment for the prime coat. Full compensation for this work will be included in the contract unit price for base.

Tack Coat: There will be no direct payment for the tack coat. Full compensation for this

work will be included in the contract unit price for base surface course.

Bituminous Surface Course: The contract unit price for the various types and thickness shall be compensation in full for one square yard. Measurement shall be the number of square yards, computed by the Engineer, to construct the surface course in accordance with the plans.

END OF SECTION 32 12 16

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Posts, rails, and frames.

B. Wire fabric.

C. Manual gates with related hardware.

D. Accessories.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2023.

C. ASTM F567 - Standard Practice for Installation of Chain-Link Fence 2023.

D. CLFMI CLF-SFR0111 - Security Fencing Recommendations 2014.

E. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric) 1990.

1.03 SUBMITTALS

A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Chain Link Fences and Gates: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Master-Halco, Inc: www.masterhalco.com/#sle.
   2. Merchants Metals: www.merchantsmetals.com/#sle.

2.02 COMPONENTS

A. Line Posts: 1.9 inch diameter.

B. Corner and Terminal Posts: 2.38 inch diameter.

C. Fabric: 2 inch diamond mesh interwoven wire, 9 gauge, 0.1483 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.

D. Tension Wire: 9 gauge, 0.1483 inch thick steel, single strand.

E. Tie Wire: Aluminum alloy steel wire.

2.03 MATERIALS

A. Posts, Rails, and Frames:
   1. Line Posts: Type I round in accordance with FS RR-F-191/1D.
   2. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.

B. Wire Fabric:

2.04 MANUAL GATES AND RELATED HARDWARE

A. Hardware for Single Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; fork latch with gravity drop and padlock hasp; keeper to hold gate in fully open position.

B. Hardware for Double Swinging Gates: 180 degree hinges, 2 for gates up to 60 inches high, 3 for taller gates; drop bolt on inactive leaf engaging socket stop set in concrete, active leaf latched to inactive leaf preventing raising of drop bolt, padlock hasp; keepers to hold gate in fully open position.

C. Hinges: Finished to match fence components.
   1. Brackets: Round.
   2. Mounting: Center.
   3. Closing: Manual.

2.05 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

2.06 FINISHES

A. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 ounces per square foot.

B. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: Verify that areas are clear of obstructions or debris and ____.

3.02 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

END OF SECTION 32 31 13

SECTION 32 31 19 - DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Decorative aluminum gates.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Design Calculations: For high wind load areas, provide calculations for gate panels and accessory selection as well as line post spacing and foundation details. See CLFMI WLG 2445 for line post and spacing guidance.

C. Shop Drawings:
   1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

D. Manufacturer's Warranty.

1.03 DELIVERY, STORAGE AND HANDLING

A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.04 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Decorative Metal Gates: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Alumi-Guard: www.alumi-guard.com/#sle.
   2. Ameristar Perimeter Security, USA: www.ameristarfence.com/#sle.
   3. Superior Aluminum Products, Inc; Basis of Design: Series 7V Privacy Railing: www.superioraluminum.com/#sle.
   4. Ultra Aluminum Manufacturing Inc: www.ultrafence.com/#sle.

2.02 GATE

A. Gates: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
   1. Capable of resisting vertical load, horizontal load and infill performance requirements for gate categories defined in ASTM F2408.

B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
   1. Total Coating Thickness: 2 mils, minimum.

2. Coating Performance: Comply with general requirements of ASTM F2408.
    a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
    b. Corrosion Resistance: ASTM B117, ASTM D714 and ASTM D1654; 1/8 inch coating loss or medium No.8 blisters after 1,500 hours.
    c. Impact Resistance: ASTM D2794; 60 inch pounds.
    d. Weathering Resistance: ASTM D523, ASTM D822/D822M and ASTM D2244; less than 60 percent loss of gloss.

C. Aluminum: ASTM B221.
1. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
2. Extrusions for Posts and Rails (Outer Channel): 6005-T5 alloy.
3. Extrusions for Pickets and Rail (Inner Slide Channels): 6063-T5 alloy.

D. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match gate components.

E. Hinges: Finished to match gate components.
1. Brackets: Square.
2. Mounting: Center.
3. Closing: Self.

F. Latches: Finished to match gate components.
1. Brackets: Square.
2. Locking: Mechanical.

2.03 ALUMINUM GATE

A. Decorative Aluminum Privacy Swinging Gates:
1. Fence Panels: See "Door Schedule" on drawings for size.
    a. Panel Style: Post and pickets built to accept privacy panels..
    b. Top and bottom rails shall enter posts via machined openings. Pickets shall be 1-1/2 inch x 3/4 inch on 4-1/2" maximum centers, shall run between the top and bottom rail, and shall contain spacialized openings for privacy panels.
    c. Attach panels to posts with manufacturer's standard panel brackets and recommended fasteners.
2. Posts: Aluminum extrusions; 4 inches square.
3. Color: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Set gate posts in accordance with Construction Documents.

3.04 CLEANING

A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

B. Clean gate with mild household detergent and clean water rinse well.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of gate to Owner's designated representative.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION 32 31 19

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 32 33 13 - SITE BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior bicycle racks.

1.02 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2022.

1.03 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.

C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Exterior Bicycle Racks: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Bicycle Security Company; Rolling Rack: www.ameribike.com/#sle.
   2. Huntco Supply, LLC; The Rambler Multi: www.huntco.com/#sle.
   3. MADRAX, a brand of Graber Manufacturing, Inc; Heavy Duty Challenger: www.madrax.com/#sle.
   4. SiteScapes, Inc; Echo 5 Space: www.sitescapesonline.com/#sle.

2.02 BICYCLE RACKS

A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
   1. Style: Serpentine rack formed from a continuous round pipe.
   2. Capacity: Five bicycles.
   3. Mounting, Ground: Surface flange.
   4. Finish: Powder coat, maintenance-free and weather-resistant.
   5. Color: As selected by Architect from manufacturer's standard range.
   6. Accessories: Surface flange cover.

B. Materials:
   1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive bicycle racks.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

C. Do not begin installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install level, plumb, square, and correctly located as indicated on drawings (verify final location with Architect).

C. Surface Flange Installation: Anchor bicycle racks securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.

3.04 CLEANING

A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 32 33 13

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 33 10 00 - WATER UTILITIES

1.1 INTENT

It is the intent of these specifications to provide supplemental information to the contents of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings, either imaged or real, shall be brought to the attention of the engineer for clarification.

1.2 DESCRIPTION OF WORK

Extent of work is shown on the drawings.

Domestic water system work includes but is not limited to: Water mains, service laterals, appurtenances.

Comply with the requirements of applicable Section 2 sections for excavation and backfilling required in connection with water distribution system work.

Comply with requirements of applicable Section 2 sections for concrete work required in connection with water distribution system work.

Comply with requirements of applicable section of UFC 3-230-10A, Unified Facilities Criteria, Water Supply: Water Distribution.

Comply with requirement of applicable sections of UFC 3-600-01, Unified Facilities Criteria, Fire Protection Engineering for Facilities.

1.3 QUALITY ASSURANCE

Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction and the applicable standards of the American Water Works Association (AWWA).

Testing and Inspection Service: Employ, at Contractor's expense, testing laboratory to perform bacteriological testing of water mains.

It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the engineer, testing service, and applicable agency inspectors 48 hours in advance of testing and inspections.

1.4 SUBMITTALS

Prior to construction commencement, the Contractor shall submit for approval by the engineer manufacturer's certifications and cut sheets for the following items: water main

pipe, fittings, tapping sleeves, appurtenances. Test Reports: Submit the following applicable reports directly to the Engineer from the testing services with copy to Contractor: Bacteriological Test Reports.

1.5 PRODUCTS

General: All materials shall be accordance with the Material Standard and shall, in no event, be less than that necessary to conform to the requirements of any applicable law, ordinances, and codes.

All materials shall be new, unused, and correctly designed. They shall be of standard, first grade quality and intended for the use for which they are offered. Materials or equipment which, in the opinion of the enginer, are inferior or of a lower grade than indicated, specified, or required will not be accepted.

1.6 WATER MAINS

General: Water main pipe shall be as shown on the drawings.

1.7 POLYVINYL CHLORIDE (PVC) PIPE - SMALLER THAN 4"

Pipe: All PVC pipe less than four inches in diameter shall be manufactured in accordance with ASTM D-2241, with a standard dimension ratio (SDR) of SDR 21, rated pressure 200 psi, and bear the National Sanitation Foundation Seal for potable water pipe.

All PVC pipe shall be marked using a solid No. 10 copper wire buried between 3 and 6 inches above the top of the pipe. Backfill shall be carefully placed to a depth of 3 inches by hand to assure that the wire is secured in place over the pipe. It is the intent of the paragraph to provide a means to locate PVC pipe using standard pipe location equipment. The wire shall be carried up through valve boxes and terminated at least 2 feet above the ground line to permit connecting of location equipment. Excess wire at valve boxes shall be neatly rolled and stored in the valve box for easy accessibility. Number 10 locating wire splice shall be heat sealed or water proof splicing connector.

Joints: Joints shall be "push-on" and shall meet all requirements of ASTM Standard D-3139. Each bell shall be an integral wall section joint assembly using elastomeric-gasket seals. All gaskets shall meet all requirements for performance as specified by ASTM Standard F-477.

Pipe Marking: All pipe shall be marked as prescribed in ASTM 3-2241, i.e., nominal pipe size, type of plastic pipe material, pipe dimension ratio, pressure rating, ASTM specification designation number manufacturer's name and code, and the National Sanitation Foundation Seal for potable water.

1.8 FITTINGS

General: Fittings three inches and larger shall be ductile iron manufactured in accordance with AWWA Standard C-110/A21.10 or C-153/A21.53. The minimum pressure rating for fittings shall be 250 psi.

Coating: All fittings furnished shall be cement mortar lined and coated in accordance with AWWA Standard C-104.

Anchoring Devices: All anchoring devices shall be suitable for use with mechanical joint fittings meeting ANSI/AWWA Standards C-110, and/or C-111.

All anchoring devices shall be constructed of ductile iron (at least ASTM A536 Grade 70-50-05) and manufactured in accordance with ANSI/AWWA C-110 and/or C-111.

All anchoring devices shall have a sufficient number of set screws so as to properly restrain various fittings or pipes at the rated pressure without the need for additional thrust restraint.

Retainer Glands: Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A 536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices.

The mechanical joint restraining device shall have a working pressure of at least 350 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG or equal.

Push-on joint restraints shall be similar to EBAA iron, series 800 or approved equal.

Coatings: Coatings shall be as follows:

Flange adapters shall be provided with a painted "shop coat".

Retainer glands shall be provided with a bituminous coat.

Push-on restraints shall be provided with a bituminous coat.

1.9 PRECAST THRUST BLOCKS

General: Precast concrete thrust blocks shall be manufactured to provide the minimum dimensions and construction shown on the plans. Precast thrust blocks will be subject to approval by the City.

Concrete: Refer to applicable Section 2 specification.

1.10 GATE AND TAPPING VALVES

General: Gate and tapping valves shall be resilient seat and shall comply with all requirements of AWWA Standard C-509 and the following supplemental requirements:

Valves 12 inches and smaller shall be bubble-tight at 200 psi water working pressure. Test pressure shall be twice the rated working pressure and at all times zero leakage will be maintained.

All valves shall be Class B gray iron body, non-rising stem, water valves suitable for buried vertical mounting.

Non-rising stems shall be in full compliance with AWWA specifications with cast integral stem collar and furnished of bronze conforming to ASTM B132 Alloy A.

Stem nuts shall be independent of wedge and shall be of solid bronze conforming to ASTM B-62.

Sealing mechanism shall be either a replaceable, internally-reinforced, specially-contoured, molded rubber disc seat ring attached to the face of the disc with self-locking stainless steel screws or a sealing surface permanently bonded with resilient material to meet ASTM D-429. Replaceable seat rings shall be designed such that it cannot be installed improperly.

Stuffing boxes shall be O-ring seal type with two rings located in the stem.
Low friction torque reduction thrust bearings shall be located both above and below the stem collar.

All valves shall open by turning a two-inch square AWWA operating nut.

Joints: Joints shall be mechanical joints and shall conform to AWWA Standard C-111, and all bolts and nuts for mechanical joints shall be high-strength, low-alloy steel in accordance with Section 11-6.5 of AWWA C-111. All gaskets shall be for a standard mechanical joint of BUNA-S (SBR Buna) in accordance with ANSI A21.4 and AWWA C-111. All mechanical joint accessories shall be furnished with the valves.

All valves shall be furnished with operating nuts and two (2) operating wrenches.

All tapping valves shall have flange by mechanical joint ends.

All tapping valves shall be interchangeable with other makes of tapping sleeves.

Coating: Body and cover bolts and nuts shall meet specifications ASTM A-307 and be rust proof. Valve interior shall have protective coating meeting AWWA Standard C-550.

1.11 TAPPING SLEEVES

General: Tapping sleeves shall be constructed of heavy gray cast iron, ductile cast iron, or high-strength steel and in two halves. All tapping sleeves shall be suitable for Class C and D gray cast iron, ductile cast iron pipe, and all pipe manufactured in accordance with ANSI S 21 standards.

Joints: Tapping sleeves shall seal to the pipe by the use of a confined "O" ring gasket and able to withstand a pressure test of 150 psi with no leakage in accordance with AWWA C-110. A 3/4 inch NPT test plug shall be provided for pressure testing. All bolts joining the two halves shall be high-strength, low-alloy steel in accordance with Section 11-6.5 of AWWA C-111, and shall be included with the sleeve.

The outlet branch flange shall be a 125# flange joint suitable for attachment by all other makes of tapping valves meeting AWWA standards.

Coatings: All gray cast iron and ductile cast iron sleeves shall have an outside bituminous coating in accordance with AWWA C-110 and an inside cement-mortar lining in accordance with AWWA C-104. All steel sleeves shall be finished with an epoxy coating both inside and outside.

1.12 TAPPING SADDLES

General: Tapping saddles shall be constructed of heavy gray cast iron or ductile cast iron, with the attachment straps, nuts, and washers constructed of corrosion-resistant, alloy steel in accordance with AWWA C-111. All tapping saddles shall be suitable for Class C & D gray cast iron, ductile cast iron pipe, and all pipe manufactured in accordance with ANSI A 21 Standards.

Joints: Tapping saddles shall seal to the pipe by the use of a confined "O" ring gasket and be able to withstand a pressure test of 150 psi with no leakage in accordance with AWWA C-110. A 3/4 inch NPT test plug shall be provided for pressure testing.

The outlet branch flange shall be a 125# flange joint suitable for attachment by all other makes of tapping valves meeting AWWA standards.

Coatings: Tapping saddles shall have outside bituminous coating in accordance with AWWA C-110 and an inside cement-mortar lining in the branch run in accordance with AWWA C-104.

1.13 HANDLING PIPE

General: All material, unless otherwise directed, shall be unloaded at the job site and distributed at the site of the project by the Contractor. Materials shall be handled with care to avoid damage. In loading and unloading, pipe shall be lifted by hoists or slid or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall pipe be dropped. Pipe handled on skidways must not be allowed to roll against pipe already on the ground. The Contractor shall be responsible for the safe handling of all materials. Damaged materials will not be installed.
Pipe shall be handled so as to avoid damage to the coating and lining. If, however, any part of the coating or lining is damaged by the Contractor, the repair shall be made by the Contractor at his expense in a manner satisfactory to the engineer before installation.

Pipe shall be distributed on the site of the work parallel with and opposite or near the place it is to be laid in the trench and with bell ends facing the directions in which the installation will proceed unless otherwise directed.

1.14 INSTALLATION OF PIPE

General: Upon satisfactory installation of the pipe bedding, as specified in the "Excavation and Backfill for Utility Systems" section of these specifications, a continuous trough for the pipe barrel and recesses for the pipe joints shall be excavated by hand digging so that, when the pipe is laid in the trench true to line and grade, the pipe barrel will receive continuous, uniform support, and the joint will receive no pressure from the trench bottom.

The interior of all pipe shall be thoroughly cleaned of all foreign material before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods.

All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench, piece by piece, by means of derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to pipe, pipe coating, and pipe lining. Under no circumstances shall

pipe or accessories be dropped or dumped into the trench.

The gasket material for the joint shall be properly positioned before the pipe is lowered into the trench. The joining of the pipe shall proceed in accordance with the manufacturer's requirements.

Watertight plugs shall be installed in the open ends of the pipe at all times when pipe laying is not in progress. At no time shall trench water be permitted to enter pipe.

Cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe. Wherever it is necessary to cut gray or ductile cast iron pipe which is equipped with a push-on joint type bell end, the cut end of the pipe shall be adequately beveled so as to prevent the edge of the cut pipe from cutting or tearing the gasket as the plain end is inserted into the bell of the adjoining pipe or fitting. All field-cut pipe shall be beveled by the Contractor, and the pipe "short" shall be used as part of the pipeline construction.

Whenever necessary to deflect pipe after proper homing from a straight line, either in the vertical or horizontal plane to avoid obstructions, the maximum allowable deflection shall be in accordance with the following:

Push-on Joint Pipe

Size	Maximum Deflection
4" thru 12"	3/4" per foot
16" thru 36"	1/2" per foot

Only after the pipe has been properly homed will it be allowed to deflect.
No pipe shall be laid in water or when the trench conditions or the weather is unsuitable for such work.

A vertical separation of 18 inches shall be maintained between water mains and sanitary or storm sewer. The water main shall be adjusted to provide necessary clearance. In the event of a conflict, see encasement details located on the water details drawing.

A lateral separation of 6 feet shall be maintained between water main and sanitary or storm sewer.

All sewer lines and laterals shall be located a minimum of 36 inches below grade.

Any pipe which is disturbed or found to be defective after laying shall be taken up and re-laid or replaced.

Prior to connecting new work to existing lines or appurtenances, the Contractor shall verify location and elevation of existing connection point and notify engineer of any conflicts or discrepancies.

Joints: Before laying the pipe, all lumps, blisters, and excess coal-tar coating shall be removed from the bell and plain ends of each length of pipe. The pipe ends shall then be wire brushed and wiped until clean and dry. Where mechanical joints or push-on joints are specified, oil and grease also shall be removed. Pipe ends shall be kept clean until joints are made. The plain end of pipe for mechanical joints shall be lubricated with a

soapy solution before installing the gaskets.

In making up the push-on type joint, the gasket shall be placed in the socket with a large, round end entering first so that the groove fits over the bend in the seat. A thin film of lubricant (approved by the pipe manufacturer) shall then be applied to the inside surface of the gasket that will come in contact with the entering pipe. The plain end of the pipe to be entered shall be thoroughly brushed with a wire brush and placed in alignment with the bell of the pipe to which it is to be joined. The joint shall be made up by exerting sufficient force on the entering pipe so that the plain end is moved past the gasket until it seats as per manufacturer's recommendation.

Backhoe buckets or excavation equipment are not to be applied directly to the pipe.

Mechanical joints shall be centered in the bells. Soapy water shall be brushed over the gasket just prior to installation. The gasket and gland shall be placed in position, the bolts inserted, and the nuts tightened finger-tight. Mechanical joints shall be assembled in accordance with AWWA Standards.

The bolts shall be tightened on opposite sides of the pipes by means of a torque wrench in such a manner that the gland shall be brought up evenly into the joint. The following range of bolt torques shall be applied:

Bolt Size (Inches)	Range of Torque
3/4" Diameter	85 to 95 ft.-lbs.
1" Diameter	95 to 100 ft.-lbs.

If effective seal is not obtained at a maximum torque listed above, the joint shall be disassembled and reassembled after thorough cleaning.

If a joint is defective, it shall be cut out and entirely replaced or, if permission is given by the engineer, it may be repaired by a suitable clamp.

1.15 INSTALLATION OF FITTINGS, VALVES AND TAPS

Fittings: Fittings shall be handled with care to avoid damage. All fittings shall be loaded and unloaded by lifting, and under no circumstances shall fittings be dropped, skidded, or rolled. Fittings shall not be placed, under any circumstances, against pipe or other fittings in such a manner that damage could result. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior lining of fittings. If any part of the fittings' coating or lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor, at his expense, in a manner satisfactory to the engineer before installing. Fittings shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud, or other foreign matter. All fitting gaskets shall be stored and placed in a cool location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.

Fittings shall be set and joined to the pipe in a manner specified previously for joint assembly. When conditions warrant, fittings should be provided with special support trussing and blocking.

1.16 ANCHORAGE OF BENDS, TEES, AND PLUGS

General: Adequate precautions shall be taken to prevent the separation of joints at bends, tees, and plugged ends.

Details: Details of design, construction, applications, installation, and number of joints necessary for the restraint of a given thrust shall be as shown in the Construction Details. Under no circumstances will gray iron pipe be used at restrained joints. Ductile iron pipe will be used unless otherwise specified by the engineer.

Thrust Blocking: Where reaction or thrust blocking is required, it shall be of concrete of a mix not leaner than one cement, two and one-half sand, five stone and having a compressive strength of not less than 3,000 pounds per square inch after 28 days and shall have a minimum curing time of three days. The poured concrete shall be left exposed for a minimum of 24 hours before backfilling, but not more than 48 hours. Before concrete thrust blocks are covered, contractor will have City inspect placement.

Blocking shall be placed between undisturbed earth and the fitting to be anchored; the area of bearing on pipe and on ground in each instance shall be that shown in the Construction Details. The blocking shall, unless otherwise directed, be so placed that the pipe and fitting joints will be accessible for repair.

Precast thrust blocks may be used in lieu of poured-in-place blocks on eight inch and smaller water mains only. Approval by the Department must be obtained. This type of block must be manufactured in accordance with the Construction Details. The engineer has the authority to reject any damaged block or any block considered to be of questionable quality. Placement will be in accordance with standard procedures for restraining thrust. Earth behind such blocks will be either undisturbed or compacted to a minimum of 95% AASHTO T-180.

1.17 INSTALLATION OF VALVES

General: Valves shall be handled with care to avoid damage. All valves shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded, or rolled. Valves shall not be placed, under any circumstances, against pipe or other fittings in such a manner that damage could result. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage. If any part of the valve's coating and lining is damaged by the Contractor, the repair or replacement shall be made by the Contractor, at his expense, in a manner satisfactory to the engineer before installing. Valves shall also be stored at all times in a safe manner to prevent damage and kept free of dirt, mud, or other foreign matter. All valve gaskets shall be stored and placed in a cool location out of direct sunlight and out of contact with petroleum products. All gaskets shall be used on a first-in, first-out basis.

Gate valves and butterfly valves shall be set and joined to new pipe in the manner heretofore specified for cleaning, laying, and joining pipe.

Valve Boxes: Cast iron valve boxes shall be firmly supported and maintained centered and plumb over the operating nut of the valve by the Contractor with box cover flush with the surface of the finished pavement or at such other level as may be directed. All valve boxes set in non-paved areas shall have concrete pads poured around the top section of the valve box. The pad shall be 24 inches square or 24 inches in diameter and shall be centered on the valve box. All water department valve covers shall be painted safety blue as prescribed by the American Public Works Association (APWA) uniform color code for utility systems.

Blow-Offs: Blow-offs shall not be connected to any sewer or submerged in any stream or be installed in any other manner that will permit back-siphonage of contaminated water .

The valve and valve box shall be installed so water department personnel can insert a valve key through the valve box and completely open and close the valve.

1.18 INSTALLATION OF TAPS BY CONTRACTOR

General: All material supplied, and drilling and tapping equipment used to make taps, will be sterilized in accordance with AWWA Standards.

After the tapping sleeve and valve have been installed and before the tap is made, the sleeve will be tested to ensure a watertight joint. A test plug will be provided in the sleeve and after the sleeve has been installed it will be filled with water and the pressure increased between 150 psi and 190 psi. All leaking joints will be repaired to the satisfaction of the engineer at the Contractor's expense.

1.19 TESTING AND INSPECTION REQUIREMENTS

It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the engineer and applicable agency inspectors 48 hours in advance of testing and inspections.

1.20 HYDROSTATIC TEST

Hydrostatic Test: Perform hydrostatic pressure test for a minimum of two hours on all mains and fittings at a minimum pressure of 150 psi in accordance with AWWA C-600 and all fire mains and fittings at a minimum pressure of 200 psi in accordance with NFPA 24-8-9. Test shall occur at any convenient time upon backfill of lines and after all piping has been thoroughly cleaned and flushed to clear the lines of all foreign matter. Prior to test, allow adequate curing time for reaction blocking.

Gauges and Recorders: The Contractor shall, upon request of the Engineer, furnish certified test data for pressure gauges and recorders used on hydrostatic test equipment. At the option of the Engineer, flow meters and/or pressure gauges used for hydrostatic testing shall be equipped by the Contractor with approved strip or round chart recorders. Tests shall be made in sections not exceeding one-half mile.

Each valved section of pipe to be tested shall be slowly filled with water, and a test pump shall be installed at the low point of the section being tested. All air in line will be expelled before applying specified test pressure. To accomplish this, taps will be made, if necessary, at point of highest elevation and afterward tightly stopped with tapered brass plugs, all at the Contractor's expense.
After installation and filling of the line as specified, the hydrostatic test, which will be at least two hours in duration (two hour test period), shall proceed as follows:

The Contractor will pump his line to a pressure greater than 150 psi. At no time shall the test or line pressure exceed 190 psi. If required by the engineer, pump test equipment shall be equipped with pressure relief valves pre-set to 190 psi.

Throughout the duration of the test, the Contractor is required to maintain a minimum pressure in excess of 150 psi. The Contractor is advised that, should the line pressure

fall to or below 150 psi any time during the two-hour test, the test will be considered invalid and a re-test according to this procedure will be required. Therefore, he is advised to pump water into the line as the line pressure approaches 150 psi. The test will be conducted with a pressure variation of not more than 5 psi for the duration of the test.

At the end of the two-hour test period, the Contractor will be required to pump the pipe lines back up to the highest pressure obtained during the duration of the test period. If chart records are required for the hydrostatic test, the Contractor shall furnish flow and/or pressure charts as a condition of concluding the test.

The allowable leakage, as specified below, will be defined as any volume of water required to maintain a minimum pressure in excess of 150 psi during the duration of the test period plus that volume of water required at the conclusion of the test to bring the line pressure back up to the highest pressure obtained during the duration of the test period.

Two Hour Hydrostatic Test Allowable Leakage

Allowable Leakage for AWWA PVC Pipe

Average Test Pressure In Line, PSI					
Nominal pipe size in.	50	100	150	200	250
	Allowable Leakage Per 1000 Ft or 50 Joints, gal/hr (L/hr)				
4	.19 (.72)	.27(1.02)	.33 (1.25)	.38 (1.44)	.43 (1.63)
6	.29 (1.10)	.41 (1.55)	.50 (1.89)	.57 (2.16)	.64 (2.42)
8	.38 (1.44)	.54 (2.04)	.66 (2.50)	.76 (2.88)	.85 (3.22)
10	.48 (1.82)	.68 (2.57)	.83 (3.14)	.96 (3.63)	1.07 (4.05)
12	.57 (2.16)	.81 (3.07)	.99 (3.75)	1.15 (4.35)	1.28 (4.84)

Leakage detection at mechanical joints shall be stopped by tightening the gland (not to exceed required torque) and leaking slip joints shall be cut out and entirely replaced, or, if permission is given by the engineer, it may be repaired by a suitable clamp. Any cracked or defective pipes, fittings, valves, or hydrants discovered as a result of this pressure test shall be removed and replaced by the Contractor with sound material and then the test shall be repeated until satisfactory.

The Contractor is warned that pressure testing against existing "end-of-line" or blow-off valves is done at his own risk. Failure of these valves to hold test pressure will not relieve the Contractor of the pressure testing nor will it entitle him to any additional compensation for the extra work performed.

1.21 DISINFECTION

Disinfection: All new water lines shall be thoroughly flushed to remove all foreign material before sterilizing. The Contractor shall sterilize the water mains in accordance with the

applicable section of AWWA Specification C-651.

Bacteriological Testing: After disinfecting and final flushing and before the system is placed in service, samples shall be collected and tested by a laboratory, state certified in accordance with Chapter 403, Florida Statutes, at least two samples, taken one per day on consecutive days, shall be collected from the end of the main for each one-half mile section of main and for each branch.

If, during construction, trench water has entered the main, or if in the opinion of the engineer or job superintendent, excessive quantities of dirt or debris have entered the main, bacteriological samples shall be taken at intervals of approximately 200 feet and shall be identified by location.

Samples shall be taken of water that has stood in the main for at least 16 hours after final flushing has been completed.

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate as required by "Standard Methods for the Examination of Water and Wastewater." No hose or fire hydrant shall be used in collection of samples. A corporation cock may be installed in the main with a copper tube goose neck assembly. After samples have been collected, the goose neck assembly may be removed and retained for future use.

1.22 MEASUREMENT AND PAYMENT

General: The contract unit price for the various items shall be compensation in full for furnishing all materials, labor, equipment, tools, and incidentals necessary for the installation of the item complete in every detail in accordance with the plans and specifications.

As part of the work of this section, the Contractor may be required to remove and relocate or stockpile for reinstallation upon completion of work certain items including, but not limited to, culverts and mailboxes.

No separate compensation will be provided for these items, compensation should be included in the unit price for item to which it most logically belongs. It shall be the responsibility of the Contractor to identify and be aware of these items by both field inspection and review of the plans.

Concrete: The contract unit price shall be compensation in full for one cubic yard of concrete used for foundations, anchors, encasement for pipe or concrete piers.

Water Pipe: The contract unit price for the various sizes and types of water pipe shall be compensation in full for one linear foot of pipe complete in place. The length of pipe installed will be measured along the centerline of the installed pipe from center of installed pipe or junctions to center of junction or various ends with no deduction in measured length for specials, fittings, or valves.

Cast Iron or Ductile Iron Fitting: The contract unit price for the various sizes and types of fittings shall be compensation in full for furnishing all materials, labor, equipment, tools and incidental necessary to install and complete one fitting with required thrust blocks. All fittings including bends, tees, crosses, slums etc., will be included under this item.

Tapping Sleeve and Valve: The contract unit price for the various types and sizes shall be compensation in full for one valve with valve box, concrete pad, and valve stem extension, if required, and tapping sleeve, size to suit existing water pipe complete in place.

Rust Proof Rods for Anchorage: The contract unit price shall be compensation in full for furnishing all labor, materials, equipment, tools, and incidentals necessary to install one linear foot of anchor rod. The price shall include threading, bolts, and coating of the rod.

Removing and Replacing Paving: The contract unit price for this item will be compensation in full for furnishing all materials, labor, equipment, and incidentals to remove and replace one square yard of paving under which pipe is laid. The term "Pavement" shall be construed to mean either concrete, bituminous, cobblestones, or brick placed as a wearing surface in streets, driveways, or sidewalks; or placed as slope protection for ditches or drains. Shell surfacing, sand-clay surfacing, gravel surfacing, and other such types of surfacing will not be considered paving and will not be paid for as such. In measuring this item for payment, the length removed multiplied by a width of the inside pipe diameter plus 30 inches will be the amount paid for, or were shown as limits of payment for pavement repair on construction plans, regardless of the width removed and replaced. No additional allowance will be made for bell holes or manholes. Where flexible pavement is replaced, no additional allowance will be made for base course or asphalt tack coat.

Encasement Pipe: The contract unit price for furnishing and installing encasement pipe shall be compensation in full for furnishing all material, labor, skids, equipment, and incidentals necessary to install and complete one linear foot of the encasement pipe of various sizes and types in accordance with the plans and specifications. Measurement will be made along the centerline of the installed encasement pipe. The carrier pipe inside encasement pipe will not be included in the contract unit price for encasement pipe.

END OF SECTION 33 10 00

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 33 30 00 – SANITARY SEWERAGE FACILITIES

1.1 INTENT

It is the intent of these specifications to provide supplemental information to the contents of the construction drawings on the quality of materials, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings, either imagined or real, shall be brought to the attention of the Engineer for clarification.

1.2 DESCRIPTION OF WORK

Extent of sewer collection system work is shown on the drawings.

Sewer collection system work includes but is not limited to: sanitary sewer mains, sewer laterals (services).

Comply with the requirements of applicable Section 2 sections for excavation and backfilling required in connection with sewer collection system work.

Comply with requirements of applicable Section 2 sections for concrete work required in connection with sewer collection system work.

1.3 QUALITY ASSURANCE

Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction and the applicable standards of the American Water Works Association (AWWA), American National Standards Institute (ANSI), and the American Society for Testing and Materials (ASTM), of latest edition.

Testing and Inspection: Testing and inspection shall be performed by the Contractor.

It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Engineer, testing service, and applicable agency inspectors 48 hours in advance of testing and inspections.

1.4 SUBMITTALS

Prior to construction commencement, the Contractor shall submit for approval by the Engineer manufacturer's certifications and cut sheets for the following applicable items: Sanitary sewer pipe, fittings, service laterals, clean outs.

1.5 PRODUCTS

General: All materials shall be accordance with the Material Standard and shall, in no

event, be less than that necessary to conform to the requirements of any applicable law, ordinances, and codes.

All materials shall be new, unused, and correctly designed. They shall be of standard, first grade quality and intended for the use for which they are offered. Materials or equipment which, in the opinion of the Engineer, are inferior or of a lower grade than indicated, specified, or required will not be accepted.

1.6 GRAVITY SEWER

General: Sewer pipe construction shall be as shown on the drawings. Furnish ells, tees, reducing tees, wyes, couplings, increasers, crosses, transitions, and end caps of same type and class of material as conduit, or of material having equal or superior physical and chemical properties as acceptable to the Engineer.

1.7 (RESERVED)

1.8 DUCTILE IRON PIPE

Pipe: All ductile iron pipe shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and a minimum elongation of 10% as specified by AWWA C-151/ANSI A21.51. Thickness shall be a minimum of Class 52 in accordance with AWWA C-151/ANSI A 21.51.

Joints: Joints for ductile iron pipe shall be either of the slip-on type using a single rubber gasket, or mechanical joints in accordance with AWWA C-110/ANSI A 21.10.

Coatings: All pipe shall be cement mortar lined and seal coated in accordance with AWWA C-104. The lining thickness shall be standard thickness. Pipe shall receive interior and exterior bituminous coating in accordance with ANSI A-21.6, A-21.8, or A-21.51.

1.9 POLYVINYL CHLORIDE (PVC) PIPE

Pipe: PVC pipe shall be manufactured in accordance with ASTM D-3034 and D-1784. All PVC pipe shall meet the dimension requirements of standard dimension ratio (SDR) 35.

Joints: Joints for PVC sewer pipe shall be of the bell and spigot type conforming to ASTM D-3212 using factory installed, flexible elastomeric seals. The elastomeric seals shall conform to ASTM F-477.
Pipe Marking: All pipe shall be marked as prescribed in ASTM 3-2241, i.e., nominal pipe size, type of plastic pipe material, pipe dimension ratio, pressure rating, ASTM specification designation number manufacturer's name and code, and the National Sanitation Foundation Seal for potable water.

Coatings: Not required.

Cutting: PVC sewer pipe may be field cut using hand or power saws in accordance with the manufacturer's recommendations. The raw spigot end thus formed shall be filed to remove gasket damaging burrs and to form a standard bevel.

Fittings: PVC sewer pipe fittings shall comply with ASTM D3034, ASTM 3212, and have elastomeric seals conforming to ASTM F-477.

1.10 INSTALLATION OF PIPE

General: Upon satisfactory installation of the pipe bedding, as specified in the "Excavation and Backfill for Utility Systems" section of these specifications, a continuous trough for the pipe barrel and recesses for the pipe joints shall be excavated by hand digging so that, when the pipe is laid in the trench true to line and grade, the pipe barrel will receive continuous, uniform support, and the joint will receive no pressure from the trench bottom.

The interior of all pipe shall be thoroughly cleaned of all foreign material before being lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods.

Pipe laying shall proceed up grade with spigot ends pointing in the direction of flow. Before pipe is joined, gaskets shall be cleaned of all dirt and stones and other foreign material. The spigot ends of the pipe shall be lubricated lightly with a lubricant specified by the pipe manufacturer and approved by the Engineer. Sufficient pressure shall be applied to the pipe so as to properly seat the socket in the bell of the pipe. All pipe shall be laid straight, true to the lines and grades shown on the drawings in each manhole section.

Under no circumstances shall pipe be laid in water or when trench conditions or the weather is unsuitable for such work, except by permission of the Engineer. At all times when work is not in progress, the exposed ends of all pipes shall be fully protected by a board or other approved stopper to prevent earth or other substances from entering the pipe.
A horizontal separation of 10 feet shall be maintained between water main and sanitary sewer. A lesser horizontal separation may be used between water main and sanitary sewer if the bottom of the water main is 18 inches above the top of the sanitary sewer and located in a separate trench and if the lesser horizontal separation is specifically dimensioned on the plans or if prior approval is obtained from the Engineer.

At crossings a vertical separation of 18 inches shall be maintained between the outside of the water main and the outside of the sanitary sewer. The crossing shall be arranged so that the sanitary sewer joints will be equidistant and as far as possible from the water main joints. Special structural support will be provided for the water main if necessary. If necessary, the water main shall be adjusted to provide the necessary clearance. If clearance between the water main and sanitary sewer is less than 18 inches, the sanitary sewer shall be encased in concrete as detailed on the plans.
All sewer lines and laterals shall be located a minimum of 30 inches below grade and 36 inches below top of pavement.

Any pipe which is disturbed or found to be defective after laying shall be taken up and relayed or replaced.

Prior to connecting new work to existing lines or appurtenances, the Contractor shall verify location and elevations of existing connection point and notify Engineer of any conflicts or discrepancies.

Wyes or tees of specified diameter shall be inserted in the sewer lines wherever designated. All branches thus inserted, unless connected with a lateral, shall have at least one joint of pipe laid from the wye and shall be closed by means of covers or plugs. The covers or plugs shall have a factory-molded joint of the same type as used in the main line and shall be of the same material as used in the main line except that approved PVC plugs may be used in V.C. branches.

At each wye, a strip of 1 x 2 cypress lumber or treated southern pine extending from the bottom of the trench to within one foot of the street surface shall be placed to facilitate finding the connection after backfilling.

Where laterals are called for on the plans, or instructed by the Owner, they shall be laid to a point two feet back of the existing or proposed curb line or as the Owner may direct. Ends of laterals shall terminate 2' above grade as required to serve the adjacent property. In sewers over eight feet in depth, or where directed, stacks shall be carried up from the wye connections at an angle of 45 degrees with the vertical, and the end shall terminate 2' above grade for laterals. The ends of the stacks or laterals shall be closed with covers as specified for wye branches. A mark shall be scribed permanently in concrete curbs, gutters, or valley gutters where present for location of laterals. Materials for stacks and laterals shall be as shown on the drawings or designated in the proposal.

Whenever pipe laying is stopped for the night or for any other cause, the end of the pipe shall be securely closed with a stopper to prevent the entrance of water, mud, or other obstructing matter, and shall be secured in such a manner as to prevent the end pipe from being dislodged by sliding or other movement of the backfilling.

Wherever house laterals are intercepted by the excavation for the new sewer, connection shall be maintained temporarily to the old sewer until the particular section of new sewer is completed and tested. Then the house lateral shall be broken and reconnected to the new sewer through a wye which shall have been placed in the sewer for that purpose.

The dead end of the house lateral shall be capped with a cover or plug as specified for wyes as close as is practical to the side of the excavation from which it emerges. If necessary, special concrete support shall be placed for these new house connections. The method of support will be determined in the field and concrete so placed will be paid for at the unit price bid per cubic yard.

After each pipe is laid, it shall be partly backfilled and made secure before the next joint is laid.

Ductile Iron Pipe: Installation shall be in accordance with the manufacturer's recommendations and the ductile iron pipe research association publication "A Guide for the Installation of Ductile Iron Pipe".

Polyvinyl Chloride Pipe: Installation shall be in accordance with the recommended practices in ASTM D-2321 and Uni-Bell standard UNI-B-5.

Transportation: Care shall be taken during transportation of the pipe that it is not cut, kinked, or otherwise damaged.

Handling Pipe Lengths: Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipes.

Storage: Pipes shall be stored on level ground, preferable turf or sand, free of sharp objects which could damage the pipe.

Stacking of polyvinyl chloride pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary, due to ground conditions, the pipe shall be stored on wooden sleepers,

spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with sleeper or between supports.

Handling Pipeline: The handling of joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Sections of the pipe with deep cuts and gouges shall be removed.

Lowering Pipe Into Trench: Care shall be exercised when lowering pipe into the trench to prevent damage to, or twisting of, the pipe.

Special Precautions: Polyvinyl chloride pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between the pipe and the joint with the rigid structures is possible.

Joint Adaptors: Make joints between ductile iron pipe and other types of pipe with standard manufactured ductile iron adapters and fittings.

Closing Abandoned Utilities: Close open ends of abandoned underground utilities which are indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed.

Close open ends of concrete or masonry utilities with not less than eight inch thick brick masonry bulkheads.

Close open ends of conduit with plastic plugs, or other acceptable methods suitable for size and type material being closed. Wood plugs are not acceptable.

Interior Inspection: Inspect pipe to determine whether line displacement or other damage has occurred.

Make inspections after lines between manholes, or manhole locations, have been installed and approximately two feet of backfill is in place and at completion of project.

If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects to satisfaction of Engineer.

1.11 UNDERGROUND STRUCTURES

Precast Concrete Manholes: Place precast concrete sections as shown on drawings. Where manholes occur in pavements, set top of frames and covers flush with finish surface. Elsewhere, set top three inches above finish surface, unless otherwise indicated.

Use epoxy bonding compound where manhole steps are mortared into manhole walls.

Provide rubber joint gasket complying with ASTM C 443. Provide drop manholes as shown on plans.

1.12 JOINING PIPE TO MANHOLES OR OTHER STRUCTURES

Downstream Side: A flexible pipe joint shall be installed within three feet of the outside face of the manhole wall, and encased to within three inches of the bell of the second pipe. For PVC only, a second flexible pipe joint shall be installed within 24 inches of the first

flexible pipe joint. All flexible pipe joints shall be kept clean of mortar and other materials that might bind the joint.

No flexible joint provisions are required for PVC pipe except that first length of pipe entering manhole shall be maximum of three feet long and an approved standard groutable PVC-to-manhole fitting shall be used.

If approved by the Engineer, a flexible rubber boot of the type described for use at the upstream manhole connection may also be used at the downstream manhole connection. Any annular space inside the manhole at the connection shall be filled with approved caulking material or joint filler.
Upstream Side (including services): A flexible pipe joint shall be installed within eight inches of the outside face of the manhole wall and encased to the end of the bell. This encasement shall not extend beyond the end of the bell so that the flexibility of the joint is maintained. For VCP only, a second flexible pipe joint shall be installed within 24 inches of the fist flexible pipe joint. All flexible pipe joints shall be kept clean of mortar and other materials that might bind the joints. No flexible joint provisions are required for PVC pipe except that last length of pipe entering manhole shall be maximum of three feet long and an approved groutable, PVC-to-manhole fitting shall be used.

Stubouts for future mains shall be constructed at the locations and to the elevations shown on the plans. The manhole benches shall be constructed to direct flows from all shown manhole inlets smoothly to the outlet. Stubouts shall be plugged as detail shown on the plans.

No short joint or cut joints required with D.I.P.

Clay pipe shall be cut only with patented pipe shears or a power saw.

If approved by the Engineer, in lieu of multiple flexible pipe joints near the manhole wall, a flexible rubber boot cast into the manhole opening or installed following casting and coring of the manhole section may be supplied. The connector shall be manufactured of neoprene or isoprene compounds formulated and tested to resist deterioration due to sewage, hydrogen sulfide, oils, fats, greases, petroleum products, and by-products. The connection at the manhole wall shall be flexible and watertight.

1.13 TESTING AND INSPECTION REQUIREMENTS

Flashing Lines: Upon completion and in the presence of the Engineer, the sewer lines shall be flashed between manholes in each straight or working section of the sewer, a round circle of light from the finished or other end of the section shall remain constantly in plain view throughout the entire length of each section and shall show the true character and shape of the interior surface of the sewer. The test shall be applied for each working section after the sewer is completed in all respects and before it is accepted. On completion of the sewer lines, the Contractor may be required to float a ball through any line. In each case, the size of the ball is to be one inch in diameter less than the sewer through which it is to pass.

Leakage: All gravity sewers, manholes, and service connections shall be tested for leakage as soon after backfill as is practical. Service connections shall be provided with watertight plugs or end caps; properly braced and capable of withstanding test pressures.

The total infiltration or exfiltration of any section of sewer shall not exceed 100 gallons per

mile of pipe per 24 hours per inch of nominal pipe diameter. Manholes shall be considered as equivalent diameter pipe for leakage determination purposes.

TEST PROCEDURE – After a manhole to manhole reach of pipe has been backfilled to final grade, prepared for testing and the specified waiting period has elapsed, the plugs shall be placed in the line at each manhole and secured.

It is advisable to seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the alignment of the pipe during plug testing.

It is advisable to plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug, and thus not revealed by the air test.

LINE PRESSURE – Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater above the pipe, but not greater than 9.0 psig. If groundwater is present, refer to Section 8 – Determination of Ground Water Elevation and Air Pressure Adjustment."

PRESSURE STABILIZATION – After a constant pressure of 4.0 psig (greater than the average groundwater back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

TIMING PRESSURE LOSS – When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater back pressure). The air hose from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average back pressure of any ground water over the pipe). At reading of 3.5 psig, or any convenient observed pressure reading between 3.5 psig and 4.0 psig (greater than the average groundwater back pressure),. Timing shall commence with a stop watch or other timing device that is at least 99.8 percent accurate.

A predetermined required time for a specific pressure drop shall be used to determine the lines acceptablility. Traditionally, a pressure drop of 1.0 psig has been specified. However, other pressure drop values may be specified provided that the required holding times are adjusted accordingly. If the specified pressure drop is 0.5 psig rather than the more traditional 1.0 psig, then the required test times for a 1.0 psig pressure drop must be halved. Specifying a 0.5 psig pressure drop is desirable in that it can reduce the time needed to accomplish the air test without sacrificing test integrity. Therefore, the following

subsections contain provisions for both the traditional 1.0 psig pressure drop and the more efficient 0.5 psig pressure drip. All requirements for a specified 0.5 psig drop are given in parentheses.

DETERMINATION OF LINE ACCEPTANCE – If the time shown in Table I (or Table II), for the designated pipe size and length, elapses before the air pressure drops 1.0 psig (or 0.5 psig); the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even through the 1.0 psig (or 0.5 psig) drop has not occurred.

DETERMINATION OF LINE FAILURE – If the pressure drops 1.0 psig (or 0.5 psig) before the appropriate time shown in Table I (or Table II) has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

LINE REPAIR OR REPLACEMENT – If the section fails to meet these requirements, the Contractor shall determine at his own expense the source, or sources, of leakage, and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the Engineer. The extent and type of repair which may be allowed, as well as results, shall be subject to the approval of the Engineer. The completed pipe installation shall then be retested and required to meet the requirements of this test.

DETERMINATI0N OF GROUNDWATER ELEVATION AND AIR PRESSURE ADJUSTMENT

APPLICABILITY – The requirements of this Section shall only apply where groundwater is known to exist or is anticipated above the sewer line to be tested.

PIPE NIPPLE INSTALLATION – During manhole installation, a one-half inch diameter threaded pipe nipple shall be installed through the manhole wall directly on top of one of the sewer pipes entering the manhole. The threaded end of the nipple shall extend no more than two inches on the inside of the manhole. The total length of the nipple shall exceed the manhole wall thickness by no less than four inches. The pipe nipple shall be non-corrosive and resistant to chemicals common in domestic sewage. Special attention shall be given to providing a permanent, watertight seal around the pipe nipple at the manhole wall. The pipe nipple shall be sealed with a threaded one-half inch cap. Every manhole need not have a pipe nipple. A few key manhole locations shall be sufficient to establish a groundwater profile for the test area. The Engineer shall assist the Contractor in selecting appropriate manholes for pipe nipple installation.

GROUNDWATER ELEVATION – Immediately before air testing, the groundwater level shall be determined by removing the threaded cap(s) from the nipple(s) nearest the section to be tested, blowing air through the pipe nipple(s) to remove any obstructions, and then connecting clear plastic tube(s) to the pipe nipple(s). Each plastic tube shall be held vertically to allow groundwater to rise in it. After the water level in the tube has stopped rising, a measurement of the height in feet of water over the invert of the sewer pipe shall be taken. If the section to be tested is not immediately adjacent to an installed

pipe nipple, the groundwater height shall be estimated based upon nearby height readings and the pipe's invert elevation.

AIR PRESSURE ADJUSTMENT – The air pressure correction, which must be added to the 3.5 psig normal test starting pressure, shall be calculated by dividing the average vertical height, in feet of groundwater above the invert of the sewer pipe to be tested by 2.31. The result gives the air pressure correction in pounds per square inch to be added. (for example, if the average vertical height of groundwater above the pipe invert is 2.8 feet; the additional air pressure required would equal 2.8 divided by 2.31 or 1.2 psig. This would require a minimum starting pressure of 3.5 plus 1.2 or 4.7 psig.) The allowable pressure drop of 1.0 psig (or 0.5 psig) and the timing in Table I (or Table II) are not affected and shall remain the same.

MAXIMUM TEST PRESSURE – In no case should the starting test pressure exceed 9.0 psig. If the average vertical height of groundwater above the pipe invert is more than 12.7 feet, the section so submerged may be tested using 9.0 psig as the starting test pressure. The 9 psig limit is intended to further ensure workman safety and falls within the range of the pressure monitoring gauges normally used.

RE-SEALING OF PIPE NIPPLES – After the groundwater height has been determined each pipe nipple shall be recapped and sealed to prevent any future infiltration.

TEST TIMES – The Ramseier test time criteria requires that no test section shall be accepted if it loses more than Q cubic feet per minute per square foot of internal pipe surface area for any portion containing less than 625 square internal pipe surface area. The total leakage from any test section shall not exceed 625 Q cubic feet per minute.

ALLOWABLE AIR LOSS RATE – A Q value of 0.0015 cubic feet per minute per square foot shall be utilized to assure the Owner of quality pipe materials, good workmanship and tight joints.

TEST TIME CALCULATIONS – All test times shall be calculated using Ramseier's equation:

$$T = 0.085 (DK) / Q$$

Where: T = Shortest time, in seconds, allowed for the air pressure to drop 1.0 psig.

K = 0.000419 DL, but not less than 1.0 psig

Q = 0.0015 cubic feet/minute/square feet of internal surface

D = Nominal pipe diameter in inches and

L = Length of pipe being tested in feet.

For more efficient testing of long test sections and/or sections of larger diameter pipes, a timed pressure drop of 0.5 psig may be used in lieu of the 1.0 psig timed pressure drop. If a 0.5 psig pressure drop is used, the appropriate required test times shall be exactly half as long as those obtained using Ramseier's equation for T cited above.

TESTING MAIN SEWERS WITH LATERAL SEWERS – It is often convenient to include connected lateral sewers when testing sewer mains having lateral sewers. If the lateral sewers are included in the test, their lengths may generally be ignored for computing required test times. This can be done because in practice, ignoring the branch, lateral or house sewers will normally increase the severity of the air test whenever the tested surface area is less than 625 square feet so that the total rate of rejection may only be increased about 2 percent. If the total tested surface area is greater than 625 square feet, ignoring the lateral sewers will only slightly decrease the severity of the test.

In the event a test section, having a total internal surface area less than 625 square feet, fails to pass the air test when lateral sewers have been ignored the test time shall be recomputed to include all lateral sewers using the following formula:

$T=0.085\ ((D_1^2L_1+D_2^2L_2+\ldots+ D_n^2L_n) / (D_1L_1+D_2L_2+\ldots+ D_nL_n))*(K/Q)$

Where: T = Shortest time in seconds, allowed for the air pressure to drop 1.0 psig.

$K = 0.000419\ (D_1L_1+D_2L_2+\ldots+ D_nL_n)$, but not less than 1.0;

$D_1\ D_{2,,\ etc.}$ … = Nominal diameters of the different size pipes being tested;

$L_1\ L_2\ _{etc}$ … = Respective lengths of the different size pipes being tested.

If the recomputed test time is short enough to allow the section tested to pass, then the section shall be presumed to be free of defects and comply with this specification.

SPECIFIED TIME TABLES – To facilitate the proper use of this recommended practice for air testing, the following tables are provided. Table 1 contains the specified minimum times required for 1.0 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert. Table II contains specified minimum times required for a 0.5 psig pressure drop from a starting pressure of at least 3.5 psig greater than the average back pressure of any groundwater above the pipe's invert. Both tables also include easy to use formulas for calculating required test times for various pipe sizes and odd lengths.

ALLOWABLE TIME TABLE

TABLE 1

Minimum Specified Time Required for a 1.0 PSIG Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015

Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:46	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

ALLOWABLE TIME TABLE

TABLE 2

Minimum Specified Time Required for a 0.5 PSIG Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015

Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23

Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug which can become a high velocity projectile. Gauges, air piping manifolds and valves shall be located at the top of the ground. No one shall be permitted to enter a man hole where a plugged

Pipe is under pressure. Four (4) pounds (gauge) air pressure develops a force against the plug in a 12 inch diameter pipe of approximately 450 pounds. A safety release device set to release at 10 pounds per square inch is to be provided between the air supply and the sewer under test.

The CONTRACTOR shall furnish all labor, tools, equipment and materials for the test. The test must be scheduled at a time acceptable to the ENGINEER and shall be witnessed by his representative.

DEFLECTION TEST – When PVC pipe is used, tests for the pipe deflection shall be run on a random basis with the ENGINEER determining the number and location depending on project size and soil conditions encountered. Deflection shall be measured by pulling a mandrel or other device capable of measuring pipe I.D. of the deflection tests run, 100% must fall within 5% maximum (95% of pipe nominal I.D.). Any lines found to exceed 5% shall be corrected prior to acceptance and shall be cause for additional lines being tested.

In all sections of the gravity collection lines, the minimum acceptable variation from a straight barrel alignment will be a visible “half moon” of light when peering from one manhole to another with only enough light shining on the end of the opening (not down the pipe) to make it visible. Anything less than a “half moon” will be cause for rejection of that section of line and reconduct all test at no cost to the OWNER.

The CONTRACTOR shall provide all equipment, labor and materials required and conduct test in the presence of a representative of the ENGINEER. Segments failing the deflection test shall be relayed to secure acceptable test results at no additional cost to the owner.

PRESSURE TEST FORCEMAINS – When the forcemains have been installed, backfilled and all thrust blocking is in place and has been adequate time to cure, the forcemain shall be subjected to a hydrostatic pressure test. The CONTRACTOR is to furnish all equipment, to be conducted in the presence of a representative of the ENGINEER.

The CONTRACTOR shall fill the forcemain with water, plug the ends, bring the pressure in the line to 100 pounds per square inch (p.s.i.). If after 30 minutes the pressure in the forcemain has not dropped below 95 p.s.i. pressure, the pressure test will be acceptable. If the test is not acceptable, the CONTACTOR will find and repair the leak and then retest the line until the line passes.

END OF SECTION 33 30 00

PANAMA CITY BEACH
FIRE STATION #32
HUTCHISON BLVD
BID DOCUMENTS
AUGUST 1, 2023

SECTION 33 40 00 - STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 INTENT

It is the intent of these specifications to provide supplemental information to the contents of the construction drawings on the quality of material, execution, measurement, etc. These specifications are general in nature and may contain products and requirements which are not applicable to the project. Discrepancies between these specifications and the construction drawings either imagined or real shall be brought to the attention of the Owner's Engineer for clarification.

1.02 DESCRIPTION OF WORK

Extent of storm sewer collection system work is shown on drawings.

Storm sewer collection system work includes, but is not limited to, the following:

Storm sewer piping; manholes, frames and gratings; grate inlets, frames and gratings; outfall structures; junction boxes; end walls; mitered end sections; rip-rap; skimmer.

Comply with the requirements of applicable Division-2 sections for excavation and backfilling required in connection with a storm sewer system work.

Comply with requirements of applicable Division-2 sections for concrete work required in connection with storm sewer collection system work.

1.03 QUALITY ASSURANCE

Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.

Testing and Inspection: Testing and inspection shall be performed by the Owner's Engineer and the Contractor's Geotechnical Engineer at the Contractor's expense.

It will be the responsibility of the Contractor to coordinate all testing and inspections. The Contractor shall notify the Owner's Engineer, testing service and applicable agency inspectors 48 hours in advance of testing and inspections.

1.04 SUBMITTALS

Prior to construction commencement, the Contractor shall submit for approval by the Owner's Engineer manufacturer's certifications and cut sheets for the following applicable items: Precast items; outfall structure; skimmer; grates; lids; frames; stone for rip-rap.

PART 2 - PRODUCTS

1.05 CONDUIT MATERIALS

Reinforced Concrete Pipe (RCP): ANSI/ASTM C 76, Class III, Wall 'B', with modified tongue-and-groove compression gasket joints complying with ANSI/ASTM C 443. All Reinforced Concrete Pipe (RCP) installed under paved areas to have tongue and groove compression gasket installed with filter fabric wrap around exterior of each pipe joint.

1.06 CONCRETE STRUCTURES

Concrete Base: Precast or cast-in-place, at Contractor's option. Use concrete which will attain a 28 day compressive strength of not less than 3000 psi. Refer to applicable Division 2 Specifications. Use reinforcing steel with a yield strength of 60,000 psi in accordance with ASTM A 615.

Precast Concrete Structures: ANSI/ASTM C 478, size and modifications as indicated.

Cast-In-Place Concrete Structures: Use concrete with a minimum 28 day compressive strength of not less than 3000 psi. Refer to applicable Division 2 Specifications. Use reinforcing steel with a yield strength of 60,000 psi in accordance with ASTM A 615.

1.07 MASONRY MATERIALS

Concrete Masonry Units:	ANSI/ASTM C 139.
Manhole Brick:	ANSI/ASTM C 32, Grade MS.
Sewer Brick:	ANSI/ASTM C 32, Grade SS.
Masonry Mortar:	ANSI/ASTM C 270, Type M.

For minor amounts of mortar, packaged materials complying with ANSI/ASTM C 387, Type M, will be acceptable.

1.08 METAL ACCESSORIES

Manhole Frames and Covers: Grey cast iron in accordance with ANSI/ASTM A 48, Class 30 B. Manhole frames and covers shall be traffic rated.
Manhole Steps: Grey cast iron, ANSI/ASTM A 48, Class 30 B, integrally cast into manhole sidewalls, unless otherwise indicated.

Grates and Frames: Grates and frames for inlets shall be either cast iron or steel as shown on the drawings. Cast iron grates and frames shall be grey cast iron in accordance with ANSI/ASTM A 48, Class 30 B. Steel grates and frames shall be structural steel galvanized in accordance with ASTM A 123. Grates and frames shall be traffic rated.

1.09 RIP-RAP

Sand-Cement: The Portland cement used in sand-cement rip-rap will not be subject to testing provided it is from an approved source and the product of an established and reputable manufacturer.

The fine aggregate shall be clean, sharp builder's sand from an approved source.

The sacks shall be jute sacks or any suitable sacks of any material which will hold the sand-cement mixture without leakage during handling and which is permeable or

absorptive enough to permit the passage of water when wetted. The sacks shall be of uniform size and dimensions and free from holes. Only one type and size of sack shall be used on any one structure.

Rubble: Shall consist of either broken stone or broken concrete, as specified on the drawings. Rubble shall be roughly angular and shall be reasonably free from thin, flat or elongated pieces. Rubble shall be of a graded mixture, with individual pieces weighing, in general from 20 to 300 pounds each. Not over 25% of the total volume shall be composed of pieces weighing less than 50 pounds each, and at least 50% of the total volume shall be composed of pieces weighing 100 pounds or more.

Broken stone shall be sound and durable quarry stone material with specific gravity of at least 1.90. The stone shall be free of cracks, soft seams and other structural defects.

PART 3 - EXECUTION

1.10 INSTALLATION OF CONDUIT

General: Install conduit in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

Inspect conduit before installation to detect apparent defects. Mark defective materials and promptly remove from site.

Lay conduit beginning at low point of a system, true to grades and alignment indicated with unbroken continuity of invert.

Place bell ends or groove end of pipe facing upstream.
Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements and other special installation requirements.

Concrete Pipe: Install in accordance with applicable provisions of American Concrete Pipe Association "Concrete Pipe Field Manual", unless otherwise indicated.

Place circular concrete pipe with elliptical reinforcing so that reference lines indicating top of pipe are not more than 5 degrees from vertical plane through longitudinal axis of pipe.

Cleaning Conduit: Clear interior of conduit of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.

In large, accessible conduit, brushes and brooms may be used for cleaning.

Place plugs in ends of uncompleted conduit at end of day or whenever work stops.

Flush lines between manholes if required to remove collected debris.

Closing Abandoned Utilities: Close open ends of abandoned underground utilities which are indicated to remain in place. Provide sufficiently strong closures to withstand hydro-static or earth pressure which may result after ends of abandoned utilities have been closed.

Close open ends of concrete or masonry utilities with not less than eight inches brick

masonry bulkheads.

Interior Inspection: Inspect conduit to determine whether line displacement or other damage has occurred.

Make inspections after lines between manholes, or manhole locations, have been installed and approximately two feet of backfill is in place and at completion of project.

If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects to satisfaction of Engineer.

1.11 UNDERGROUND STRUCTURES

Masonry Construction Structures: Masonry construction will not be allowed unless specified on detail drawings.

At Contractor's option, use either sewer brick or concrete masonry units to construct masonry structures.

Mix mortar with only enough water for workability. Re-tamping of mortar will not be permitted. Keep mortar mixing and conveying equipment clean. Do not deposit mortar upon, or permit contact with the ground.

Lay masonry in mortar so as to form full bed with ends and side joints in one operation, and with full bed and vertical joints, not more than 5/8 inch wide. Protect fresh masonry from freezing and from too rapid drying.

Apply a ½ inch thick mortar coating on both interior and exterior wall surfaces. Where structure occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops three inches above finish surface, unless otherwise indicated.

Use an epoxy bonding compound where steps are mortared into masonry walls.

Precast Concrete Structures: Place precast concrete sections as shown on drawings. Where structures occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops three inches above finish surface, unless otherwise indicated.

Use epoxy bonding compound where steps are mortared into structure walls.

Provide rubber joint gasket complying with ASTM C 443.

Connections: Make connections to existing conduits and underground structures, so that finished work will conform as nearly as practicable to requirements specified for new work.

Take care while making connections to prevent concrete or debris from entering existing conduit or structure. Remove debris, concrete or other extraneous material which may accumulate.

1.12 BACKFILLING

GENERAL: Conduct backfill operations of open-cut trenches closely following laying,

jointing and bedding of pipe, and after initial inspection and testing are completed.

Placing Asphalt: The asphalt shall be placed by a machine or other methods which will provide a pavement surface true to line grade and cross sections.

Sand-Cement Rip-Rap: The sand and cement shall be mixed dry, in the proportions of five cubic feet of sand to one bag of cement until the mixture is of uniform color. The mixed material shall be accurately measured into each sack, with care being taken to place the same amount in each sack, and allow the top six inches of the sacks to remain unfilled to allow for proper tying and folding and to insure against breaking of the sack during placing. The sacks shall be laid with broken joints, in a regular pattern with all tied and folded ends in the same direction. The sacks shall be rammed or packed against each other so as to form a close and molded contact after the sand and cement mixture has set up. Sacks ripped or torn shall be removed and replaced. All openings between sacks shall be filled with dry grout composed of one part Portland cement and five parts sand. All sacks shall then be thoroughly saturated with water.

Rubble Rip-Rap: Rubble shall be placed and arranged to form a compact layer conforming to the neat lines called for and to the specified thickness; plus or minus three inches. The rubble shall be placed in such a manner that the small pieces are not segregated but evenly distributed. The voids shall be filled with cement grout composed of one part Portland cement and five parts sand.

Under drains: The various sizes and types of pipe for Under drains shall be bedded firmly on the bottom of the trench, with the perforations down and joints securely made. The influent end of the pipe shall be protected in a manner which will prevent any soil from entering the drain. The trench shall be backfilled with filter material, stone, slag or crushed gravel to the lines indicated on the plans. The filter material shall be placed and compacted around the pipe and for the full width of the trench, in layers not exceeding six inches in thickness. Special care shall be taken to avoid displacement or damage to the pipe. The portion of the trench above the filter material shall be filled with suitable pervious material which shall be placed and tampered in layers not exceeding four inches in thickness.

Ditches and Detention Areas: The construction of ditches and detention areas shall include the removal and disposal of old pavement, curb, gutter, sidewalk, etc. and the removal and disposal of all vegetation. The ditches and detention areas shall be excavated, shaped and sloped in accordance with the line, grade and cross sections indicated on the plans. The excavated material shall be removed and wasted as directed by the Engineer at the Contractor's expense.

1.13 TESTING AND INSPECTION REQUIREMENTS

Flashing Lines: Upon completion and in the presence of the Owner's Engineer, the lines shall be flashed between structures in each straight or working section of the sewer, a round circle of light from the finished or other end of the section shall remain constantly in plain view throughout the entire length of each section and shall show the true character and shape of the interior surface of the sewer. The test shall be applied for each working section after the sewer is completed in all respects and before it is accepted. On completion of the sewer lines, the Contractor may be required to float a ball through any line. In each case, the size of the ball is to be one inch in diameter less than the sewer through which it is to pass.

All components of the system, including structures, shall remain uncovered until a visual inspection has been performed and accepted by the Owner's Engineer and applicable governmental agencies.

PART 4 - MEASUREMENT AND PAYMENT

General: The contract unit price for the various items shall be compensation in full for furnishing all materials, labor, equipment, tools and incidentals necessary for the installation of the item complete in every detail in accordance with the plans and specifications. There will be no direct payment for clearing, grubbing, excavating, de-watering, bracing, caulking, backfilling, clean-up and restoration of property.

Pipe: The contract unit price for the various sizes, types and depths of pipe for culverts and storm drains shall be compensation in full for one linear foot of pipe complete and in place. The length of pipe installed will be measured from end to end and center to center of manhole, junction box or inlet. Mitered end sections will not be included in the length of pipe. When depth of cut classification are shown on the Proposal Form, the classifications will be the vertical distance from natural ground surface or subgrade of roadway, whichever is least, to the pipe invert.

Manholes, Junction Boxes and Inlets: The contract unit price shall be compensation in full for one manhole, junction box, or inlet of the various sizes, types and depths complete with frames and covers or grates, steps, inverts, connections and stub-outs in place. The depth of manhole, junction box or inlet shall be the vertical distance from the top of the manhole, junction box or inlet to the lowest pipe invert.

End walls: The contract unit price for the various sizes and types, including all reinforcing and concrete necessary, shall be compensation in full for one end wall or head wall complete and in place.

Rip-Rap: The contract unit price for the various types shall be compensation in full for one cubic yard of rip-rap complete and in place.

Under drains: The contract unit price for various sizes, types and depths of Under drains shall be compensation in full for one linear foot of under drain complete and in place. The length of under drain installed will be measured from end to end.

Mitered End Sections: The contract unit price for the various sizes and types, including all pipe, reinforcing, connections, anchors, concrete, sand, sod and incidentals necessary shall be compensation in full for one mitered end section complete and in place.

END OF SECTION 33 40 00